THE HAWAIIAN PLANTERS' MONTHLY

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HAWAIIAN SUGAR PLANTERS' ASSOCIATION.

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MEETING NOTICES.

The annual meeting of the Hawaiian Sugar Planters' Association will be held at the rooms of the Association in the Judd Building, Honolulu, on Monday, November 23, 1903.

The annual meeting of the Hawaiian Sugar Chemists' Association will be held at the rooms of the Planters' Association in the Judd Building, Honolulu, on October 26 and 27, 1903.

PLANTERS' ASSOCIATION COMMITTEES.

A report is expected at the annual meeting of the Association from each committee, and the members thereof are requested to confer together in order that the reports may be as interesting as possible and embody the ideas of all the members of each committee.

The following is a list of the committees:

LABOR—W. M. Giffard, chairman; E. D. Tenney, E. F. Bishop, J. P. Cooke, E. E. Paxton.

CULTIVATION—Geo. F. Renton, chairman; H. Deacon, W. A. Baldwin, D. Forbes, L. Barkhausen, H. P. Faye.

FERTILIZATION—C. F. Eckart, chairman; Fred Meyer, C. B. Wells, J. T. Crawley, J. F. C. Hagens, C. McLennan.

IRRIGATION—H. P. Baldwin, chairman; W. W. Goodale, L. Barkhausen, J. A. Low, Geo. C. Hewitt.

HANDLING AND TRANSPORTATION OF CANE—C. C. Kennedy, chairman; A. Horner, F. B. McStocker, John Sherman, H. A. Baldwin, F. Weber.

MANUFACTURE—John A. Scott, chairman; E. E. Olding, Wm. Pullar, Andrew Adams, A. Moore, H. P. Baldwin.

MACHINERY—W. Stodart, chairman; C. Hedemann, J. A. Low, Jas. Scott, J. T. Moir, Geo. Ross.

UTILIZATION OF BY-PRODUCTS—W. W. Goodale, chairman; Jas. Gibb, Jas. Renton, W. G. Walker, Andrew Adams, G. H. Fairchild.

DISEASES OF CANE—R. C. L. Perkins, chairman; A. Lidgate, D. C. Lindsay, K. S. Gjerdrum, G. F. Renton, A. Ahrens.

FORESTRY—L. A. Thurston, chairman; H. A. Baldwin, G. N. Wilcox, T. S. Kay, G. C. Chalmers.

EXPERIMENT STATION—F. M. Swanzy, chairman; F. A. Schaefer, H. A. Isenberg, G. H. Robertson, J. P. Cooke.

We take pleasure in commencing with this number the publication of Miss Katherine Coman's paper on "Contract Labor in Hawaii." Miss Coman visited the Islands last year, and spent considerable time in the study of labor questions, and there are few who are better qualified to treat of the subject from an economic standpoint.

Miss Coman is Professor of Economics in Wellesley College; she graduated from the University of Michigan in 1880, and has ever since been connected with Wellesley College, first as head of the combined departments of History and Economics, later as Dean of the College, and since the enlargement and division of the two departments, as head of the Economics Department alone.

Miss Coman very early became interested in the conditions of working women in Boston, and was instrumental in founding and supporting settlement work in the United States, especially Denison House in Boston. She is a specialist in the study of labor questions and the author of an Industrial History of the United States. She is joint author with Professor Katharine Lee Bates of a work on English History as told by English poets, and with Professor Kendall of a work on Constitutional History. She has recently been observing the industrial condition of the negro in the southern United States.

FORESTRY.

During the past two months William L. Hall, of the Federal Bureau of Forestry, has been making a tour of the islands for the purpose of investigating and reporting upon the condition of the Hawaiian forests. The result of his examination will probably be the adoption of a forestry policy which will be carried out by the Territorial Board of Agriculture and Forestry in conjunction with the Federal Bureau.

Our forests have suffered great injury through the ravages of wild cattle, sheep and goats, by fire and by injurious insects, and in some places bid fair to be entirely obliterated unless prompt action is taken for their protection.

For some years past the local government has, with limited means at its disposal, done what it could toward protecting the forests; the provisions in the government leases of grazing lands relative to the protection of forests by the exclusion of cattle and the reserving and fencing of forest lands will be productive of much good. Private enterprise has in some places done much to protect the forests by the fencing of forests and the reservation of forest lands. But it has become absolutely essential that action be taken in all the islands to protect existing forests and set apart and replant reservations.

So far as we are informed, this is the first time systematic

study and investigation of our forest problems have been made by an experienced forester.

Mr. Hall made an oral report to the Board of Agriculture and Forestry before his return to the States, in which he made suggestions of much interest and value. Mr. Hall said that the most important matter is to shut out the animals and protect existing forests, and then to begin a system of planting. In regard to the varieties of trees to be planted, Mr. Hall urged that trees of a commercial value be selected, and thought that the redwood and red fir would probably do well in portions of the mountains. As a matter of general interest, Mr. Hall says that the virgin forests of Hawaii are the most beautiful he has ever seen; that they are unique in their beauty and attractiveness on account of the abundance of ferns and mosses everywhere to be seen.

It is hoped that this investigation will result in early and systematic action being taken in forestry matters.

THE CUBAN PROBLEM.

From the annual report of U. S. Consul-General Steinhart at Havana, extracts from which appear elsewhere in this number, and from other sources, it appears that Cuba has recuperated very rapidly from the evil effects of the insurrection since the establishment of an independent government.

Much important information is given in Mr. Steinhart's report showing the prosperity now enjoyed by the Cubans, but as affecting sugar, it is interesting to note that the crop of 1903 produced 940,000 tons, which is almost as large a crop as was ever before harvested in the island. The crop of 1904, harvesting of which will soon begin, is estimated at 1,250,000 tons, and will be in excess of anything heretofore expected of Cuba.

The report of the Consul-General also shows a great revival and increase in all agricultural industries.

The energy, pluck and perseverance of the people of Cuba, which have enabled them to bring about such magnificent results in such a comparatively short period, arouse our interest and admiration, and at the same time effectually show that the cry of "poor Cuba" and the reports of the distressing condition of affairs in Cuba, and that the sugar industry of Cuba "is paralyzed, and will perish if it does not receive a heavy tariff concession," have no foundation in fact.

The Cuban sugar crop increased from 300,000 tons in 1899-1900 to 615,000 tons in 1900-1901, and to 940,000 tons in 1902-1903. This would certainly seem to show that nothing is needed in the way of tariff concession to enable Cuba to successfully produce sugar. Surely, if the Cuban planters were on the verge of bankruptcy, as some of them testified, we

would not see such an extraordinary revival of the industry and increase in production.

It has been shown by the Cuban planters and others that sugar can be produced in Cuba cheaper than in any other country in the world—estimates of a number of disinterested persons who testified before the Committee of Ways and Means of the Fifty-seventh Congress placing the cost at 1.25c. to 1.75c. per pound. A table taken from the testimony of Special Agent Saylor given before the committee, showing the profits to Cuba on their sugars sold in our markets for 1901, is appended hereto, and shows that under existing tariff conditions Cuban sugar producers are well able to care for themselves.

Whatever disadvantages Cuba has labored under arise not from the withholding of a free market, but from the low price of sugar, which has equally affected all sugar-producing localities not bounty-fed. In former years, under Spanish rule, they produced sugar at a profit, and at that time import duties were levied by the United States. If prosperous under Spanish rule, why complain now? In common with all other sugar-producing countries, it will suffer from overproduction and low prices.

Why, then, should the American people do anything to foster Cubar sugar at a corresponding disadvantage to our own producers?

The situation with a twenty per cent. reduction on the present tariff would be about as follows:

With London beets at 8s. 10 1-4d., New York centrifugals would be worth 3.919c. The rebate to Cuba of twenty per cent. on the tariff of 1.6875c. would effect a reduction of .337c., and would therefore enable the Cuban Planter to sell at 3.582c. and still be on a parity with the London market, and yet we are told that our own sugar industry can easily stand this reduction.

That the independent Cuban planter will receive any portion of the benefit of such a concession is very much to be doubted.

The market for Cuban sugar is the United States; and if in that market there were a dozen independent buyers, the reduction given to Cuba would go to the planters. There is, however, no competition; the American Sugar Refining Company (otherwise known as the Sugar Trust) purchases at least 90 per cent. of the sugar that is refined in this country, and naturally are going to get the raw sugar for as low a price as possible.

The only active competition that this refining interest has heretofore had is from the beet sugar producers. This competition has been removed by the purchase of many of the important beet sugar factories by the trust, and it is therefore secure in its control of the situation.

And what then remains for the independent Cuban planter?

The trust, as is well known, and as demonstrated during the past sugar season, controls the production of a large number of Cuban plantations, and will sell to itself at a figure which will enable it to derive full advantage of the tariff reduction, and if the independent planter does not care to sell at this price—why, he can store his sugar until he gets ready to meet the reduction.

Dr. Wiley reported to the Ways and Means Committee in 1902 that after studying statistics very carefully, he could not see that there was any profit in the sugar industry; that taken as a whole, he did not believe the whole sugar industry of the United States, beet and cane, made a profit of one per cent. in 1901, and was in doubt if the persons engaged in the industry came out even.

It is time to talk of our sugar industry as being able to stand a reduction in its profits when there is a profit to reduce.

PROFITS TO CUBA ON THEIR SUGARS SOLD IN OUR MARKETS FOR YEAR 1901.

Total market value taken from weekly sales of Cuban sugars, including tariff and cost		$ 47,989,903
Deducting tariff	$19,576,266	
Deducting shipping	1,162,152	
		20,738,418
Net selling price of Cuban sugars		$ 27,251,485
Total amount of sugar sold in our markets for the year 1901 (pounds)		1,162,152,320

Total cost of production in Cuba:

At 1 cent a pound	$ 11,621,523
At 1 1-2 cents a pound	17,432,284
At 1 3-4 cents a pound	20,337,664
At 2 cents a pound	23,243,046

Profit on Cuban sugars at these various costs of production:

At 1 1-2 cents per pound:

Total net selling price of Cuban sugars	$ 27,251,485
Total cost of production at 1 1-2c. per pound	17,432,284
Net profit	$ 9,819,201
Net per cent. of profit	per cent. 56

At 1 3-4 cents per pound:	
Total net selling price of Cuban sugars....$	27,251,485
Total cost of production at 1 3-4 c. per pound	20,337,664
Net profit .....$	6,913,821
Net per cent. of profit.....per cent.	34
At 2 cents per pound:	
Total net selling price of Cuban sugars....$	27,251,485
Total cost of production at 2c. per pound...	23,243,046
Net profit .....$	4,800,439
Net per cent. of profit.....per cent.	17+

IMPORTS OF SUGAR INTO THE UNITED STATES FROM CUBA.

Years ended June 30.	—Quantity— Pounds.	Tons.	Value.	Import price per pound. Cents.
1891	1,430,566,475	638,646	$45,039,513	3.1
1892	1,983,540,022	885,509	60,838,765	3.1
1893	1,843,652,253	823,059	60,637,670	3.3
1894	2,127,502,319	949,778	63,147,745	3
1895	1,845,763,398	824,002	40,100,204	2.2
1896	1,093,171,312	488,023	24,102,835	2.2
1897	577,790,173	257,942	11,982,473	2.1
1898	440,225,111	196,529	9,828,607	2.2
1899	663,543,657	296,225	16,412,088	2.5
1900	705,456,230	314,936	18,243,644	2.6
1901	1,099,404,362	490,806	26,373,690	2.4

CUBA.

Report of Consul-General for 1903.

The following excerpts are taken from the Annual Report of the Consul-General of Cuba for 1903:

PLANTATIONS AND FARMS.

Sugar Plantations.—It is only a few years since the sugar industry was separated from agriculture in most of the large plantations, called "centrales." Considerable increase in the sugar production was the result, owing to the reasonable and methodic subdivision of labor.

The industrial process for the manufacture of sugar was greatly improved during the years preceding the invasion of the western provinces by the forces of the revolution initiated in February, 1895, in the eastern region of the island. With few exceptions, the centrales were furnished with furnaces for

burning green bagasse as fuel; machinery of great power, mills of large dimensions, regrinders, defibrators and defecators were established; improvements were made for the purpose of maintaining the juice at a high temperature, thus avoiding fermentation; vacuum pans for boiling, evaporating and concentrating the saccharine matter of the cane juice (called tripple-effect apparatus) were also established; and to separate the molasses from the sugar, centrifugal filters were introduced. At the same time railways were constructed in the interior of mills and factories, easily accessible laboratories were established to assure the chemical proceedings in the process of sugar manufacturing, and electric light used instead of kerosene, gasoline, etc. Railroad branches connecting the sugar mills with depots and other shipping places have been constructed to facilitate the transportation of products, and also branches of private service extending to zones where no railroads of public service have as yet been built.

For the purpose of loading carts with cane in the fields and unloading the railroad cars or on the slate gutters (cane conductors) at the mills, several devices have been patented under the name of "loaders and unloaders of cane," which are very simple, inexpensive, and great labor savers.

Sugar-Cane Colonies.—Owing to the lack of pecuniary means among the owners of lands where these colonies were established, agricultural development is rather unimportant, as the proprietors of the centraies cannot afford to advance money for the purpose of rebuilding the wrecked houses, purchase of oxen and agricultural implements, as well as for plowing and planting anew the fields; and as there are no agricultural banks in Cuba to furnish the necessary funds for this purpose, the planting of new cane lands since the end of the war has been limited.

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VALUE OF CROPS.

In 1894, one year before the outbreak of the revolution, the value of the principal products exported was as follows:

Sugar	$65,000,000
Tobacco	25,000,000
Molasses and rum	12,000,000
Coffee	1,510,000
Fruits and vegetables	1,150,000

SUGAR PRODUCTION AND EXPORT.

As to the crops in the present year, it may be said that the sugar crop amounted to 940,000 tons, although up to May 31

only 839,294 tons (of 2,240 pounds each) were delivered at the various ports in the island. Of this, 492,653 tons have been exported and 371,941 tons are held in storage. To these figures must be added 17,230 tons consumed in the island, and the 42,530 tons of sugar which were on hand January 1, 1903, from previous crop should be deducted therefrom. The difference between the figures thus realized and the 940,000 tons referred to is represented by sugar still at plantations and remaining to be delivered at some future date.

The prices obtained from the sale of sugar in January, February, March, April and May, 1903, were 1.965, 1.824, 1.774, 1.651 and 1.667 cents per pound, or an average for the five months of 1.776 cents per pound, which gives a total value of $37,395,456 to the present crop. These prices are in Spanish gold.

The following table shows sugar exported, on hand, consumption, etc., for the years 1902 and 1903:

	Exported.		On hand.	
Port of Shipment.	1902.	1903.	1902.	1903.
Habana ....sacks.	102,396	233,745	740,133	600,620
Matanzas ....do..	100,041	563,123	812,711	606,039
Cardenas ....do..	160,312	470,246	883,042	724,496
Cienfuegos ..do..	568,088	795,314	211,044	204,982
Sagua la Grande ...do..	57,732	280,038	220,809	102,423
Caibarien .....do..	50,189	154,966	251,460	213,103
Guantanamo .. do..	160,793	230,417	125,441	61,925
Cuba .....do..	41,643	86,546	17,348	16,623
Manzanillo ..do..	127,443	251,445	12,950	11,100
Nuevitas ....do..	76,500	95,895	58,694	14,374
Gibara y Puerto Padre .....do..	205,332	222,701	21,354	16,281
Zaza .....do..	13,452	7,730	8,935	10,721
Trinidad ....do..	7,000	56,407	60,000	20,900
Total sacks 1,670,921		3,448,573	3,423,921	2,603,587
Total tons	238,703	492,653	489,132	371,941
Local consumption for 5 months.tons	.....	.....	16,840	17,230
On hand Jan. 1..do.	.....	.....	19,873	42,530
Received up to May 31 .....do.	.....	.....	724,802	839,294

MOLASSES.

The molasses produced amounted to 40,000,000 gallons, of which 12,000,000 gallons of the first quality were exported from this city (Habana) to Philadelphia and 10,000,000 gallons of the second quality to other ports in the United States and to

Europe. The remainder—18,000,000 gallons—was consumed on the island. Molasses of first quality sold at 8 cents and second quality at 3 cents. The total value of the production was $1,800,000.

IMMIGRATION.

During the year 1902, 11,986 immigrants came to Cuba. Of these, 9,496 were men and 2,490 women; 8,877 were Spaniards, 1,063 Americans, 389 English, 232 Syrians, 222 Italians, 171 French, 145 Chinese, 69 Germans, and 818 from all other countries. The immigrants under 14 years of age numbered 2,523; between the ages of 14 and 45, 8,809; 45 years or over, 654. Married immigrants numbered 3,377, and 8,609 were single.

From January 1, 1903, to June 1, 1903, 3,766 immigrants arrived at Habana, Cuba, of which 3,009 were men and 757 women; 144 were Americans, 3,290 Spaniards, and 332 were from all other countries.

SUGAR AND TOBACCO.

As stated in my previous report, the 1903 crop of sugar reached the large amount of 940,000 tons (of 2,240 pounds each), and a conservative estimate of the crop of 1903-4 places the amount at 1,250,000 tons.

The exports of sugar and tobacco during the four years I have been on duty in Cuba—1899 to 1902—amounted to nearly 90 per cent. of the total exports of the island. The value of the sugar exported from 1899 to 1902, inclusive, amounted to $99,932,600; of tobacco, to $97,904,200, of which $47,890,700 was for leaf tobacco and $50,013,500 for cigars, cigarettes, and cut tobacco, thus making a total for sugar and tobacco for the four years of $197,836,800. During the same period other exports amounted to $23,743,300.

THE END OF THE BOUNTIES.

It is with the greatest pleasure that we are able to chronicle the passing into law of the British Sugar Bill to give effect to the provisions of the 1902 Brussels Convention. A long standing injustice to an old established British industry has at length met with tardy recognition, but so tardy that some of those who have been associated with the question for long years became pessimistic enough to doubt whether that incubus of fair trade, the bounty system, would ever be done away with. This was not surprising when we remember that the failures of one Convention after another were recorded with the regularity of recurring decimals, and always for the same reason, that England as a whole clung so persistently to her fetish of free trade that she would not for a moment

tolerate any suggestion of levying a countervailing duty on bounty-fed sugar. Hence the repeatedly abortive attempts. But within the last five years a change seems to have come over the minds of our leading men; old theories have been dismounted from their pedestal to make room for more modern ones; economical pedantries have ceased to hold such a sway as heretofore, and questions are beginning to be investigated on broader lines. It was not surprising then that the injustice to which the British and Colonial sugar industry had been subjected for half a century was at length seen in its true light, and that the only possible means were then taken to put an end to an iniquitous system that threatened to spread to other industries. Neither was it surprising that the opposition, whose main argument was that the jam and confectionery trades would be ruined if bounties were abolished failed signally in their attempt to wreck the measure, when we consider that on their own showing these industries are bolstered up by the worst form of protection there is, protection to the foreigner in our own markets; well might Mr. Chamberlain express his preference for an industry which asked only for fair trade in order to exist.

But the new era has at length dawned, and with it should come that necessary factor for success, security. Mr. Chamberlain complained lately that he has for some time past been trying to get financiers to interest themselves in the West Indies, but the latter had always felt that it was too risky an experiment so long as bounties existed. Now that the latter are to be a thing of the past, it is to be hoped that those individuals will reconsider their position. Should sufficient money be forthcoming, we may expect to see central factories of the most modern construction and equipment erected in the West Indies within the next few years, and the present output of 250,000 tons may increase three if not fourfold. The advantages resulting to British trade should be considerable; increased cargoes between the United Kingdom and the Colonies; increased output of sugar machinery, and increased supply of raw sugar for home refineries to work up. But we have no wish to paint too rosy a picture at so early a date. It is not to be supposed that matters will right themselves all at once; the diversion of trade from one source to another will take time. The increase in the size of the plantation and mills will be a question of years, and we are quite prepared to be told twelve months hence by our opponents that, in spite of the abolition of bounties, no appreciable increase in the exports of West Indian sugar has taken place. But while that may or may not be so, there is no doubt that we may look forward at an early date to increased supplies of foreign cane, and these will be decidedly preferable to Continental beet, for, in spite of the analyses of chemists, there is no doubt cane sugar is more nourishing than beet. But wherever our supply

may come from, it will be amply sufficient to keep down the price at its present level. The immediate effect of the Convention will be to prohibit the importation of sugars from Russia, Argentina, and Denmark; a matter of perhaps 50,000 out of a total of over 1½ million tons required in this country. This deficit could be more than made up merely by diverting some of the West Indian supplies at present going to the U. S. A. There is reason, besides, to suppose that both Argentina and Denmark will follow Peru's example and bring their fiscal arrangements in harmony with the principles of the Brussels Convention. Russia, the sole country remaining liable to penalties will doubtless persist in retaining her bounties, and will confine her exports to her Eastern dependencies.

It is curious how paradoxical are some of the arguments that have been advanced by the opponents of the sugar industry in favor of the retention of bounties. On the one hand, we are gravely told that as one result those countries which participate in the Convention will secure a monopoly of the sugar trade, and therefore raise prices. On the other hand, the suggestion that, had bounties continued, Germany and Austria would, sooner or later, have secured a monopoly of the world's sugar trade, has long been ridiculed as an impossibility, because there was a plentiful supply of sugar always available from other parts of the world. In the first case we are to believe that four or five countries, competing under conditions of practically fair trade, can secure a monopoly in our sugar markets over all the remaining sugar producing countries, because perchance two or three of the latter now render their share liable to prohibition, and in consequence reduce our available supply by less than 1-125 of the world's production. In the second case we are told that in spite of their enormous bounties (State and Cartel), enabling them to sell sugar at a profit below cost price, Germany and Austria could not possibly secure any monopoly of the sugar trade while so many other sources of supply were available. One presumes, then, that these other sources of supply would be actuated by such philanthropic motives that they would continue indefinitely to sell their unbountied sugar similarly below cost price, so as to keep up the amount of the world's available supplies. It seems to be generally overlooked that even in such progressive countries as Java and Hawaii the price of sugar has become so low since the Cartel bounties were instituted a year or two back, that profits, if any, have been very small, and a continuation of this state of affairs would have been, in many cases, little short of disastrous. Indeed, most individuals engaged in the sugar industry in those countries will welcome the abolition of bounties, knowing that it will ensure a more stable and natural market price for their sugar.—International Sugar Journal.

THE BRITISH SUGAR REGULATIONS.

An order in council has been issued in London promulgating regulations for the importation of sugar into the United Kingdom in accordance with "The Sugar Convention Act" passed at the recent session of Parliament. Great Britain by this Act goes farther than the United States in dealing with the importation of "bounty-fed" sugar, for it authorizes His Majesty by an order in council absolutely to prohibit importing or bringing into the United Kingdom any sugar from a country that grants any "direct or indirect bounty" on its "production or export," and the present order gives effect to the prohibition as well as imposes regulations upon all importation. The "permanent commission" provided for in the Brussels Convention has reported that a bounty on exportation is granted in Denmark, Russia and the Argentine Republic, and the importation of sugar from those countries into Great Britain is prohibited "from and after the first day of September next." This fortifies the decision of our Government regarding Russian sugar, not only with the action of the British Government but with that of all the signatories of the convention, which include Germany, France and Austria-Hungary, as well as certain smaller producers of beet sugar.

The British regulations require all sugar imported into the Kingdom to be accompanied by a certificate indicating the kind and quantity, the kind, number and marks of the packages, the country of production, of origin, or of manufacture, and the country of destination, and the mode of carriage by land or water. It must be signed and issued "by the fiscal authority having jurisdiction in the country of production, of despatch and of transformation, such fiscal authority being duly empowered for that purpose by the Government of the State." If the country of origin is not a party to the convention, the certificate must also "state that the goods are derived from a factory which does not work sugar coming from either Russia, Denmark or the Argentine Republic," and any such certificate "must as a guarantee of due signature and issue be vised by the proper British Consul." By another order adopted the same day "every sugar factory and sugar refinery and factory for the extraction of sugar from molasses in the United Kingdom" is made subject to the supervision of the Commissioners of Customs or the Commissioners of Internal Revenue, apparently a further precaution against the "transformation" of any of the illicit product in the Kingdom. Thus the policy is established, until Parliament shall take different action, of absolutely excluding all sugar produced or made in countries that pay a bounty, direct or indirect, either on production or exportation.—The Journal of Commerce and Commercial Bulletin.

CONTRACT LABOR IN THE HAWAIIAN ISLANDS.

BY KATHARINE COMAN.

The problem of converting a tropical country inhabited by a primitive people to the uses of modern industry has been solved in diverse ways by the Spanish in Cuba and the Philippines, by the Dutch in Java and East Sumatra, by the English in British Guiana and the Straits Settlements, by the Belgians in the Congo Free State. In each case zeal for money profit, for the financial success of the enterprise in question, has been moderated and held in check by concern for the well-being of the land and people in process of exploitation. Of these two contending impulses, the industrial is likely to dominate the men immediately concerned in the business enterprise, while the humanitarian comes to the front in the home country, where advantage in the profits derived is but indirect and where wrong done to the nation's honor and prestige is keenly felt.

The experience of the Americans who undertook to civilize the Hawaiian Islands is peculiar in that they enjoyed seventy-five years of immunity from outside interference. The measures determined upon for the development of the country were their own. There was no colonial office to over-rule the local policy. Every candid observer, however, must concede that there was nothing arbitrary in the methods of the missionaries, the white men who were in the long run most influential in directing the course of legislation in the Hawaiian Islands. Although the processes of civilization were never gentler or less destructive of native autonomy, the decay of aboriginal society when brought in contract with an advanced social order was no less inevitable here than in regions where relations between the aboriginal and the civilized races were less happy. Within the cycle of a hundred years a primitive agricultural community was transformed into a highly specialized industrial system in which every capacity of land and people is subsidized for the promotion of a single product.

This primitive organization was closely analogous to that which we know as feudal. There was no absolute title to land; the right to exploit definite tracts was allowed to the chiefs by the king or over-chief. The taro patches were cultivated and all other productive labor was performed by the common people for the benefit of the chief on whose land they dwelt. Like the serfs of mediæval Europe, the common people rendered service in products and in labor. The product service was in swine, dogs, vegetables, fruit, fish-lines and fish-nets, calabashes, kapas and the precious red and yellow feathers from which the cloaks and helmets of state were manufactured. Labor service varied with time and place and gave greater opportunity for extortion. When the trader's demand

for sandal-wood began to exhaust the supply, the serfs were forced to penetrate the dense forests of the mountain tops and bring down heavy loads on their bare shoulders. Thousands died of the unaccustomed cold and fatigue.

The regulation of labor service was one of the first reforms attempted by the missionaries. The laws promulgated by Kamehameha III, at Lahaina in 1839, limited and defined the labor tax as follows: "During the first week of the month, the people are to work two days for the king and one day for the chief on whose land they dwell. In the second week of the month, they work one day for the king and two days for the chief. When public work is to be done (the building of roads, bridges, fish-ponds, irrigating ditches and the like), the people must work three days in each of the last two weeks of the month until the work be accomplished." Women caring for children were exempt from the labor tax. Money fines were imposed for neglect of service; for each day withheld, fifty cents; for each half day, twenty-five; for tardiness, twelve and a half cents. These fines were paid to the king or to the chief who suffered the labor loss. On the other hand, the chief who exceeded the labor requirement set by this law must pay a fine to the king and forfeit for six months his claim to the labor of the serfs so over-worked. Fines for failure to perform public works were imposed in the same proportion as for private service. A man might exempt himself from all obligation to personal service by the payment of nine dollars per year, four dollars and fifty cents to the king and four dollars and fifty cents to his chief.

With the distribution of lands in 1848, service tenure was abolished and the people were exempted from the labor service due to king and chief. But a public labor tax of twelve days a year was continued; this might, however, be commuted at fifty cents a day (1850). Thenceforth the taro patches of the chiefs must be cultivated by wage-paid labor. Moreover the presence of missionaries and traders created a demand for service that could be met only by a free labor class. As early as 1841 a law was published respecting the hire of labor. "Labor hire as well as other kinds of hire has at the present time become an extensive business. There are persons who obtain their whole living and property by laboring for hire. The law does not condemn that business for it is proper. The law protects it. It would be a sad thing for the community if the law did not give protection to him who labors for hire." This law was enacted by the newly organized legislative body which, being composed in the main of the large land owners, was naturally concerned for the employer's interest. Its provisions give evidence that the native labor was not always worthy of his hire. The labor agreement must be faithfully performed by both parties. If the laborer was indolent so that he accomplished little, his wages might be diminished in pro-

portion to the employer's loss. If the work was imperfect or was left incomplete or if the employer should suffer material damage by any fault of the laborer, the laborer's wages might be diminished or entirely withheld according to the loss sustained.

Another new and extra-feudal demand for labor had arisen with the advent of the whaling vessels. Whalers first visited Hawaii in 1820. From that year until 1871, when, the major part of the fleet having been destroyed in the ice off Cape Belcher, the business encountered overwhelming loss, the stout Yankee ships were accustomed to use the Islands as a supply station, stopping both on the outward and homeward cruise. In the roadstead between Lahaina and the island of Lanai as many as one hundred vessels were sometimes anchored. The whalers came in pursuit not of food and water only. The Hawaiians were famous sailors, and it was customary to take on a crew of brawny kanakas for service in the north seas. By 1846, it was thought advisable to regulate this employment. The act authorizing the enlistment of native sailors provided that application for permission to enlist natives on a foreign vessel must be made to the governor of the island to which they belonged, and that shipping articles must be deposited with him stating the name and nationality of the vessel, the destination, object, and term of service proposed. The master of the vessel must further execute a bond to the amount of one hundred dollars for each man so enlisted as surety for the payment of his personal taxes and for the just fulfilment of the contract. The sailor on his part could give no bond, but the authorities were made responsible for him. "The governors shall have power, after the provisions of the preceding articles are fully complied with, to compel the embarkation of any subjects of these Islands so voluntarily enlisted by a foreign captain, and for that purpose, in case of desertion, he may cause them to be arrested and conveyed on board."

Still another labor demand, destined to be far greater and more permanent, developed with the systematic cultivation of sugar. Sugar cane grew luxuriantly on the Islands, and a low grade sugar had been manufactured as early as 1823, the cane being crushed between wooden rollers and the juice boiled down in open kettles; but the cultivation of the cane on plantation scale was not undertaken until 1835. In this year a mill was erected at Koloa on Kauai, and the industry was fairly inaugurated. By 1838 twenty-two mills were in operation, the windward side of Hawaii and Maui proving to be as well adapted as Kauai to the culture of the cane. It was soon demonstrated that the Islands afforded almost ideal conditions for the growing of sugar—fertile soil, abundant rainfall, and a climate so equable that the cane could be brought to full maturity and the highest percentage of saccharine matter de-

veloped. These natural advantages guarantee the Hawaiian sugar planter today a yield three or four times as great as that of Cuba or Louisiana. Disadvantages quite as permanent and inevitable are the distance from the world markets and the scarcity of labor.[1]

The scarcity of labor began to be recognized as a serious handicap to the industrial development of the Islands as early as 1850. A law of that year recites: "Whereas, the native population is diminishing" and the "want of labor is severely felt by planters and other agriculturists, the price of provisions being thereby enhanced," and "whereas many natives have emigrated to California and there died in great misery, be it enacted that no native subject of the king may leave these islands without express permission given on proved necessity." The planters soon discovered that the cultivation of sugar on a profitable scale required a very considerable land area and an abundant supply of low-grade labor. Every subsequent improvement in the industry, every new application of machinery has emphasized this dual necessity. Steam-plows, irrigation from pumping stations, hauling of the cane by rail, enhanced capacity of the mill—each effort to reduce cost of production involves an increased expenditure by way of fixed capital that is justified only by proportionate increase of the area to be cultivated. Moreover the vicissitudes of a sugar crop require that masses of labor be brought to bear without delay at the given time and place. Cane must be cut when it is ripe or the stalks grow dry and woody. Once cut, the cane must be got to the mill within three days or it sours and is unfit for use. Thousands of dollars may be lost by a delay of a few hours.

By 1850 it was becoming painfully evident that the native population would be quite inadequate to meet this labor demand. The Hawaiians were disinclined to the steady, monotonous labor required in the cane-fields, and, moreover, the race was dying out with startling rapidity. Captain Cook's estimate of the population of the Islands in 1779 was 400,000. He was probably deceived by the crowds of people who came to the coasts to see the marvelous visitors, the fire-breathing gods. A more conservative estimate rates the population in the discovery epoch at 300,000. The missionaries in 1823 reckoned the population at 142,000. The first census, taken in 1832, enumerated 130,313. Four years later a second census was taken, and but 108,579 were returned. A third census, taken in 1850, gave the native population 84,165 and the foreign 1,962. The native race has continued to decline in numbers. The census of 1900 enumerates 29,799 Hawaiians, and 7,857 part Hawaiians, in a total population of 154,000.

[1] According to W. C. Stubbs, director of the Louisiana Agricultural Experiment Station, the Louisiana average is one and one-half tons of sugar per acre, the Cuban from one to two tons, while the plantations of Hawaii boast an average yield for five tons; but in Hawaii it takes from three to six months longer to mature the crop.

The year 1850 marks the initiation of a systematic effort to meet the labor demand of the planters. In that year the legislative assembly legalized two forms of labor contract hitherto unknown to these islands, apprenticeship and indentured service. The Act for the Government of Masters and Servants, so far as it concerned apprentices, closely resembles that of Massachusetts. It provides that minors may be bound out as apprentices or servants by father, mother, or guardian, or by the governor of the island—boys from ten to twenty years, girls from ten to eighteen years. The contract, which must be signed by both parties, binds the master to teach reading, writing, and, in case of a male, arithmetic, and requires that the recompense to be rendered to the minor at the end of term be plainly stated. Charges of cruelty or misusage may be brought against the master by the parents, guardian, or governor, or by the apprentice himself after expiration of his term. In case such a suit is sustained, the apprentice is discharged and the damages recovered become the property of said minor. In case an apprentice departs from service, the justice on complaint of the master must issue a warrant for his apprehension. The captured apprentice must be returned to his master and is bound to render additional service for double the time of his absence, provided such service does not exceed the year immediately following the original term. The same act provides that a person more than twenty years of age may contract himself to service for a term not exceeding five years. If a laborer so bound wilfully absents himself from service he may be apprehended, restored to his master, and bound to additional service of double the time of absence. If he refuses to serve, he may be committed to prison and confined at hard labor until he will consent to serve according to contract. A second desertion may be punishable by three months at hard labor for the state, in addition to the service due his master. If the master, on the other hand, has been convicted of cruelty, misusage, or violation of contract, he may be fined from five dollars to one hundred dollars, and, in default of payment, be confined at hard labor until the same is paid.

The legislation declaring the terms under which an adult might contract his services for a term of years was an adaptation of the American shipping law. It was probably suggested by the practice of taking service on the whaling ships above alluded to, indeed, engaging for service on a plantation is still termed "shipping" in Hawaii. The analogy with the terms of indentured service in the American Colonies is also evident. The bond servant of colonial Virginia, whether working out a penal sentence or making good the cost of his passage, was equally under obligation to serve to the end of his term. An attempt to escape was sharply dealt with. The sheriff summoned the men of the hundred to follow with hue and cry, and

the runaway, if captured, was compelled to serve an additional term of double the time of his absence.

That in the thought of the legislators of 1850 the laborer contemplated by the Master and Servants Act was the kanaka is made evident in an amendment of 1868, providing that the contract was to be printed in both English and Hawaiian. A legal form was provided with blanks for inserting the names of parties to the contract, the place, the terms, and the wages agreed upon. A specimen contract: By this indenture the owners of Hana Plantation, Island of Maui, of the first part, agree with Kealaula of the second part as follows: 1. I, Kealaula, agree to work faithfully and diligently for said owners of Hana Plantation for the term of eighteen months, from the first day of September, 1874, (each month to consist of 26 days labor) in their service and at such place as they or their agents may assign me to work, not less than ten hours work per day. 2. The owners of Hana Plantation aforesaid agree faithfully to pay to Kealaula the sum of eight dollars ($8) for each month of faithful service to the end of the term specified above, and also to provide him with poi, not with meat, until this agreement expires.

Hawaiians continued to be employed on the sugar plantations, though in ever-decreasing numbers. The number working under labor contracts was 1,319 in 1886, 399 in 1896, and 163 in 1899. A writer in the Hawaiian Annual of 1895 declares that "For all round plantation work no imported unskilled laborers have proved their (the kanakas') equal"; but the natives who must work for their living prefer to do so as teamsters and cow-boys or as sailors. Field labor is not to their mind.

The impossibility of supplying the plantations with native labor was clearly forseen in 1850, and a section was incorporated in the Master and Servants Act to the effect that "all engagement of service contracted in a foreign country to be executed in this" are valid except that "engagements made for a longer period than ten years be reduced to that limit." This is the legal basis of the contract labor system of the Hawaiian Islands. Under this law, in force from 1850-1897, one hundred and fifteen thousand laborers were imported into the Hawaiian Islands, and the resources of the country were developed to a degree that would have been quite impossible had the planters been restricted to native labor or to voluntary immigration. The history of this labor system, of the attempts made to regulate and control it, and to maintain American institutions alongside of it, constitutes a most interesting phase of human history.

The Royal Hawaiian Agricultural Society was founded in 1850 with a view to promoting the interests of the planters along various lines. The labor problem, being to the fore, naturally engaged the first energies of the association. The

prospectus set forth that "The introduction of coolie labor from China to supply the places of the rapidly decreasing native population, is a question that is already agitated among us, and, should such a step become necessary, the aid of such an association would become of great benefit." Two years later, the society engaged Captain Cass of the bark Thetis to bring in Chinese laborers under contract as provided for by the Master and Servants Act. The one hundred and eighty coolies so imported were bound to serve for a term of five years at three dollars per month in addition to passage prepaid and food, clothing, and shelter provided by the planter who had engaged their services. The cost of transportation was fifty dollars per man, and maintenance per man was estimated at five dollars per month. The cost of the labor may therefore be reckoned at about nine dollars a month. Later in this same year Captain Cass brought in one hundred more Chinese coolies. The experiment was highly satisfactory, and the president of the society in his annual report congratulated the country on securing such "quiet, able, and willing men."

The satisfaction of the laborers was no less, if we may judge from a statement published in the Chinese Mail: "The coolies shipped for South America are hired laborers and, according to some accounts, virtually slaves; but we are told that it is otherwise with those sent to the Sandwich Islands. Fortunately that traffic was undertaken by a man of much humanity and good sense; and, according to the account that we have received from one who speaks from actual observation but who has no connection with or interest in the adventures. Captain Cass entered into engagement with the planters of the Sandwich Islands to import Chinese laborers for the sugar plantations,—the planters binding themselves to pay the laborers four dollars a month from the time of their arrival, while coolies, house-servants, and gardeners have been engaged at salaries as high as sixteen dollars; and as the wages are not promised merely but paid, and the coolies are well treated, they are not only contented but have urged their friends at home to join them."

The importation of aliens was naturally regarded with jealousy by the Hawaiians. Kamehameha III (1852) undertook to transport the whole population of Pitcairn's Island to the royal estates, hoping thus to secure tenants and cultivators closely allied to the native race in blood and language. This project failed because the English consul refused to allow the deportation of the islanders unless they came as British subjects. Since this might jeopardize the newly won and much prized independence of the islands, the scheme was abandoned. Kamehameha IV, repeatedly urged the importation of Polynesians with a view to recruiting the native stock. There was a strong sentiment in favor of providing, not labor for the planters merely, but men and women of vigorous

physique who should marry with the Hawaiians and so replenish the deserted fields. But the prime concern of the planters was to grow sugar-cane. They did not wish to be burdened with women and children. Moreover, it was by no means clear that natives of the South Sea islands were any more inclined to monotonous field labor than were the Hawaiians.

The hope of reinvigorating the native stock was not abandoned. However, the fifth Kamehameha came under the influence of a man who, first and last, had much to say concerning the labor problem in the Hawaiian Islands. Walter Murray Gibson, an adventurer of dubious precedents acquired large estates on the island of Lanai and there conducted a series of immigration experiments. To his mind the problem was primarily a population problem. A permanent labor supply could only be provided by importing a people vigorous and prolific and thus repleting the energies of the exhausted Hawaiian race. Gibson strenuously urged the introduction of Polynesians under the patronage of the state. In 1864 the legislature voted an appropriation of $36,000 for the transplanting of a considerable number of Polynesians of both sexes. "For their support and employment" the immigrants were to be bound to service for a given term. But the law declared that all such contracts should provide, as far as might be, that the employers should receive as many women as men, and that suitable provision should be made for the support of such women." In 1869 the Mauna Loa was sent to the Caroline Islands for the first shipment of Polynesians under government auspices. She brought back eighty men, women and children, and these were hired out to planters on the island of Oahu, since the government desired to have the experiment under immediate observation. The men were to be paid four dollars per month and the women three dollars in addition to food, clothing, and shelter, and the planter was to pay thirty dollars toward the passage money of each Polynesian in his employ. In a second expedition the Mauna Loa secured forty-two men and women from Danger Islands. They were contracted for at a slightly advanced wage; men four dollars and fifty cents, women three dollars and fifty cents.

This altogether praise-worthy undertaking suffered the fate of many another optimistic attempt to improve on the natural order of things. It was denounced as man-stealing, or in facetious phrase, "black-birding." In its issue of March 12, 1869, the New York Tribune announced: "The coolie trade in the Sandwich Islands has, for sometime past, taken on a development which leaves but little difference between it and the slave trade. It is especially the natives of the small Polynesian islands who are imported, often entirely against their will, and compelled to work." There is no evidence as to any complaint of ill-treatment on the part of these people, but they sickened in the strange environment. They proved quite un-

satisfactory as laborers, moreover, and were, in accordance with the agreements made with them, returned to their homes at the expense of the government. The men who were instrumental in forwarding this immigration scheme should not be judged by rumor as to what was done or left undone on those hazardous cruises in the South Seas, but by the orders given to their agents. To the recruiting agent in the South Sea Islands the president of the Board of Immigration wrote: "The point upon which I insist is that our honor and good name must be protected, that no means of any kind in any way disreputable be used in obtaining these people." And again, "I make this a condition that you do not trade in rum, guns, or ammunition while gathering these people for us." Captain Jackson of the Stormbird, who was sent to Rotumah in 1878, was instructed to "use all fair and just means to induce these people to emigrate to these islands, and bear in mind we are anxious to have women and children as well as men."

Private recruiting for South Sea islanders was later allowed, but only on condition that the immigrants should be under control of the Board of Immigration and that the following instructions be observed by shipmasters: "1. Vessels must be fitted out with all comforts and supplied with food, water, and medicines sufficient for the number of people that the laws of the Kingdom allow them to carry, and no liquor, guns or ammunition shall be taken for purposes of trade. 2. All acts in procuring labor shall be honest and above reproach and no deception of any kind used. They shall thoroughly interpret and fully explain to all the people what is expected of them, as well as, the kind of labor, pay and food. 3. To make contracts for not less than three years at five dollars, six dollars and seven dollars a month for the first, second and third year respectively, and for women four dollars, five dollars and six dollars along with food, house and bed-clothing. Their taxes to be paid by their employers and their wages payable in cash at the end of each month. If they so desire they shall be returned to their homes at the expiration of their contract. 4. To bring as many women as men and the children belonging to the families. To make no contracts with children, and those under fourteen years to go to school free of expense. No work to be done on Sunday and no master to strike a servant." In 1880 Rev. H. Bingham was appointed special inspector for the South Sea islanders. His duties were defined as follows: "To make tours on the several islands of the group where there are South Sea islanders employed, to inspect their general treatment and condition, to report when necessary any violation of the laws, the regulations of the Board or the conditions under which they (the islanders) were engaged, to inspect the quarters, food and arrangements for medical care and enquire into any complaints that they may have to make, explaining to them their rights and their duties and helping them by ad-

vice to obtain redress in case of wrong; to see that their children are given the facilities for education in district schools, and report to the Board such modification of contracts or other arrangements as might to him appear to conduce to the well-being of the people, as also all statistics that he may gather."

(To be continued.)

MANUFACTURE OF SUGAR IN HAWAII.

BY E. KOPKE.*

As has been announced in a former meeting, the subject of the manufacture of sugar on these Islands will be taken up before this Association, but more especially the machinery employed in the sugar houses.

This paper is intended to give an outline only of the subject in hand, and after this, the discussions on any part of the process or any particular machine will be in order.

In order to realize where we stand today, it may be interesting to look back and see how the manufacture of sugar has developed in these Islands during the last thirty-five years.

The history of the sugar industry in these Islands has been so ably written about by Mr. H. M. Whitney, late editor of the Planters' Monthly, and others, that it seems to me to be a waste of time to repeat what they have already stated. I would refer you to those papers, which can be found in the Planters' Monthly.

About forty years ago the machinery used in manufacture of sugar was quite different from the machinery employed today.

A sugar house of that time had a three-roller mill, with no cane or trash carrier, was driven by animal or water-power, and rarely with steam; an open train, which served the purpose of cleaning and concentrating the juices; a strike pan, in which the juice was boiled to a finish; coolers for first and molasses sugars; centrifugals for drying the sugars and purging out the molasses, and a limited number of boilers, which served to drive the mill engine (if there was one), and the centrifugal engines, and for furnishing steam for the strike pan.

The fuel consisted of sun-dried bagasse and wood.

There were then employed more men and women in a factory that made, say from 15 to 20 tons of sugar per day, to dry the bagasse, hauling it to and fro on ox-carts to the drying field, hauling firewood and carrying cane to the mills, than

* This is the first of a series of papers on sugar manufacture in Hawaii to be presented to the meetings of the Honolulu Engineers' Association.

there are now employed in a modern factory which makes 150 tons of sugar per day.

While the extraction in a modern mill is as high as 95 per cent., I venture to say that 50 to 60 per cent. was high then, though I have no accurate data on this.

The juice coming from the mill was strained and pumped into the "open train." This open train consisted of a number of copper or iron kettles, 6 to 8 feet in diameter, set in brickwork close together over a flue.

There were four kettles in the train; the juice would enter No. 1 kettle first, and be boiled from there into No. 2; from No. 2 into No. 3, &c. The flame passing from left to right under the kettles, kettle No. 4 would boil first, and in boiling the scum would be swept with a paddle into No. 3; the scum from No. 3 into No. 2, from No. 2 to No. 1, where the scum was skimmed off and put into a settling tank, from where the clear juice was drawn off, and the mud let run into the gutter or fed to animals.

The juices from No. 4 being the cleanest, were taken into the "strike pans;" this was heated with steam, and the evaporation of the juice carried on to a desired point. When this point was reached, the concentrated juice was let into the coolers, in which the sugar would crystallize out; after having stood for some time, this mass was dug out of the coolers, conveyed in buckets to the drying machines (centrifugals), where the molasses was purged out and the crystallized sugar packed in barrels. These barrels of sugar entered the California market as Sandwich Island sugar.

The molasses was pumped into a container, where it was "blown up," i. e., steam directly blown into the liquid in order to destroy all grains of sugar; after this the molasses was boiled and concentrated in the strike pan, and treated the same as the first sugar. The sugar from this first molasses crystallized much slower than from the first sugar, and therefore had to stand in the coolers much longer than the first sugars. After drying the first molasses sugar, the resulting second molasses was treated again the same as the first molasses, but this product was often put into large tanks or cisterns, and stood sometimes for months before the sugar was sufficiently crystallized out; the molasses from this was either treated again, or went to waste.

We thus have briefly the description of the path the juice travels from the cane to the finished sugar, and the very simple method employed to obtain the final product.

If we look at a modern sugar factory, we still find the same processes, but with this difference, that machinery has been installed to either bring about a saving of labor or a greater extraction—i. e., to get as much of the available sugar in the bags as possible, or, in other words, reduce losses to a minimum.

The machinery employed may be classed as follows:

(1) Machinery for transportation, such as cane and trash carriers, pumps, and monte jus for moving liquors, such as juice, syrup, molasses, water, lime water, mud, sugar bags, &c.

(2) Machinery for extraction, such as crushers, mills and mud presses.

(3) Machinery for concentrating, as open pans, evaporators of the Multiple Effect type.

(4) Machinery for crystallization, as vacuum pans, crystallizers.

(5) Machinery, such as separators, as centrifugal machines.

(6) All machinery which is employed in the different processes, such as clarification, liming, filtering, &c.

(7) Machines for measuring and weighing.

(8) Boilers.

Now let me go over the work of a modern sugar factory in as few words as possible.

The cane arriving on cars at the mill is unloaded, after having been weighed, by mechanical unloaders onto the cane carrier, which latter conveys the cane to the crusher or shredder, thence into the mills, consisting of nine to twelve rollers.

The juice from the different mills flows through a mechanical strainer into the receiving tank of the juice pump. The bagasse is taken by a bagasse carrier directly to the furnaces, where it is mechanically fed into the furnaces.

The juice pump moves the juice into the boiling house, where the latter is either measured, or, better (but seldom), weighed, and limed. After the juice has been limed, it is clarified——that is, heated and non-fluid impurities separated from the fluids—and to accomplish this clarification there are used heaters, settlers, filters and mud presses.

After the juice has been clarified, it is then concentrated—that is, a part of its water is evaporated out, and the resulting juice is called syrup. The concentration is carried on in multiple effects under partial vacuum.

The syrup is taken into vacuum pans in which the evaporation of water from the syrup is continued under a vacuum to such a point that the sugar can no longer remain in solution, and forms into crystals; after this has been accomplished, the contents of the vacuum pan (called a strike, and the mass that has been boiled is called massecuite) is discharged into crystallizers. These drum-like crystallizers either revolve as a whole, or are stationary, and have in this case stirrers or paddles or screw-like blades in them, which are mechanically driven, so that the massecuite is constantly in motion. While I do not wish just now to describe these crystallizers in particular, I must say that the object of them is to carry on the crystallization of the sugar grains, which were started in the vacuum pan.

From the crystallizer the massecuite is taken through the so-called mixer, which is nothing but a container on which are fastened the dryers or centrifugal machines; for each machine there is a separate gate, which serves to let the massecuite flow from the mixer into the centrifugal machine.

The centrifugal machine is a strongly made and accurately balanced basket, which is fastened to a hollow spindle; the spindle is fastened to and suspended from a bracket fastened to the mixer. The basket revolves in a stationary tub, and is lined with a strong and very finely perforated brass. The spindle with the basket is revolved by either a belt, water-wheel or electric motor.

The massecuite, which is a mixture of sugar crystals and molasses, when exposed to the centrifugal force, gives up the molasses—i. e., the molasses passes through the fine perforations of the brass, and the crystals are retained.

The crystals are discharged from the basket through an opening in the bottom of the basket, and conveyed either through a dryer or directly into bagging arrangements. When in the bags, the sugar is ready for shipment.

The molasses which was purged from the massecuite runs into a cistern, from where it is pumped, and goes through a process of "blowing up," cleaning and reboiling, and often is mixed with the massecuite after it has been boiled in a vacuum pan. I would like to say a word about "blowing up."

The molasses that comes from the centrifugal machines contains small sugar crystals, or parts of crystals, every individual crystal having a tendency to grow—i. e., to absorb crystallizable sugar from the liquor surrounding the crystal. If this growth was allowed to go on, we would find a great smear after awhile, because there would be all sizes of crystals to contend with, which must be avoided for reasons which I will give when we come to the work of centrifugaling. Now, this "blowing up" with steam directly let into the molasses heats and dilutes the molasses, and this is carried on until all crystals have been dissolved; then this homogeneous liquor is evaporated in a vacuum pan to proof—i. e., so much water has been evaporated out of the molasses that the sugar cannot any longer be held in solution, and the sugar forms into crystals, which crystals, after once started, have the tendency to keep on growing, and their final size only depends upon the conditions under which the crystallizable sugar in solution can be brought in contact with the growing crystals. This is also true in regard to first sugars. We will touch this subject again when we come to "Crystallization in Motion" and "Purity of Sugar Solution." We have a way of expressing this condition of sugar solutions in a mathematical term: the coefficient of purity—i. e., the coefficient expressing the relation between total solids in solution and total pure sugar in solution. For example:

We have a juice which shows by the Brix spindle 16—that is, 16 per cent. of solids (sugars and non-sugars)—which are dissolved in the juice, and we find in the polariscopic test 14 per cent. of pure sugar in this same solution; then we have in per cent., 16 : 14 : 100 : 87.5 : 87.5 is coefficient of purity. The coefficient of purity at once shows the quality of the solution.

CANE EXTRACTION.

Cane is mainly composed of juice and wood fibre. If 100 pounds of cane contain 12 pounds of fibre, then the rest—88 pounds—must be juice, and it would be, in regard to weight of cane, 88 per cent.—while in reality the extraction obtained in good mills is about 83 to 84 per cent.—that is, a loss of 6 to 5 per cent. in 89. If the extraction is expressed with reference to 100 pounds of sugar in cane, then we find that good mills give 94 to 95 pounds per 100 in cane. So whenever there is anything said about mill extraction, one must know whether it is based on the weight of cane or on the weight of sugar.

CONCENTRATION.

This term is used whenever a sugar solution has a part of its water evaporated out, and consequently becomes thicker or concentrated. This, expressed in per cent., can be illustrated by an example.

If a solution of 15 per cent. is concentrated to a density of, say 60 per cent., we have an evaporation $\frac{60}{60}-\frac{15}{} \times 100 = 75$ per cent. by weight.

Example:

We have a sugar solution of 15 deg. Brix., which means that 15. pounds are in solution in 100. pounds; this is to be evaporated to 60 deg. Brix. What is the per cent. evaporation?

The difference in density is Y60-15, i. e., 60-15 is to the number to be found as 60 is to 100.

Equation is—

$$(60-15): \times :: 60: 100$$

$$\frac{45 \times 100}{60} = 75 \text{ per cent Evaporation.}$$

To prove this, we will figure backward.

We have solution of 15 deg. Brix., which is to be evaporated 75 per cent. What is the final Brix?

We have $15+85=100$

75 per cent of $100=75-75$

$15+10=25$

now 100 divided by $25=4$

$4\times15=60°$ Brix

$4\times10=40°$

100

POLARIZATION.

If degrees of polarization is spoken of, it is meant to explain the parts of pure sugar contained in 100 parts. So if it is said that sugar polarizes 96 degrees, this means that there are in 100 pounds of sugar 96 pounds pure sugar and 4 pounds of non-sugar.

The term polarization is derived from an instrument called polariscope. I hope to be able in some future meeting to have some one describe this very interesting instrument.

These few explanations are, I think, sufficient for the present, and I shall now ask you to follow me in describing some of the machines.

CRUSHER OR SHREDDER.

The crushers are mostly two-roller mills, with very coarse grooves or XXX in the rollers, or the rollers are made up of steel discs. Each disc is deeply grooved at 45 degrees to the center line, and every other disc is grooved right and left hand, so that the grooves, when the discs are put together on a shaft, form zigzags. The cane passing through a crusher of this kind cannot escape being mangled up in whatever way it may fall, whether square to the centre line of the roller or parallel with it. At the same time a large amount of the juice is extracted here (40 to 45 per cent.), which is a decided advantage over the shredder, which will be mentioned immediately. The crushers are either driven through gearing from the main mill engine, or have a separate engine.

The shredder operates differently from the crusher; it consists of two shafts on which are fastened discs with radial teeth. Each shaft may revolve independently, or at different speeds. In working, one shaft revolves slower than the other, so that the circumferential speeds differ. Both shafts revolve at a relatively high speed. The cane entering the shredder is exposed to the tearing action of the teeth, and not to pressure; the cane becomes shredded and falls into a chute, which delivers it into the first mill. The cane passing through the shredder, and not being exposed to pressure, does not yield juice.

The aim of both crusher and shredder is to prepare the cane for the first mill, so that it may be fed as evenly as possible into it; therefore they increase the capacity of the mills, and expose the machinery to practically even pressures, which is of great importance in regard to good extraction, as well as safety to the machinery—varying feed means varying strains. The crushed or shredded cane passes now through the first mill. This mill, as all following ones, is to press out as much juice as possible. The pressed cane, called bagasse, is treated to a shower of hot water as soon as it comes out of the mill

(this process of putting water on the bagasse is called maceration); the remaining juice in the bagasse becomes diluted, and is partly extracted in the second mill; the bagasse coming from the second mill is again macerated with hot water, and after this bagasse has been exposed to the action of a third mill, it passes off to the furnaces. The crusher and the different mills have extracted the greater part of the sugar in the cane, say 93 to 95 per cent.

In order to see what the process of milling and maceration means, it is, I think, necessary to illustrate same by an example.

Before starting on the example, allow me to give a sort of prelude. If one takes a sponge which has been saturated with ink, and wishes to remove the ink, one naturally will press out as much as can be pressed out; if the sponge is saturated after this with water, the water will dilute the ink, and if pressed out again the sponge will have lost a great part of its ink, and the oftener this saturating and pressing out is repeated, the more thoroughly will the ink be removed.

It is just this process of saturating and pressing out which is employed in the extraction of juice from cane, in order to exhaust the cane fibre of the sugar-bearing solution which it holds in its cells.

If we look at this rough diagram, showing a crusher and 3 3-roller mills, and follow the process of milling and saturation, or maceration, as it is called, and we take for an example 100 pounds of cane, containing 12 pounds of wood fibre and 88 pounds of juice, the juice having 18 pounds of soluble matter in solution, then the analysis will be as follows:

100 pounds cane equals 12 pounds fibre, 15.84 pounds soluble matter, 72.16 pounds of water (the soluble matter is mostly sugar, and if this juice has a purity of 86 per cent., the 15.84 pounds of soluble matter will split up in 13.622 pounds of pure sugar and 2.218 pounds of non-sugar).

The crusher first will extract, I will say, 75 per cent. of the total amount of normal juice in the cane; that will leave the conditions like this: 75 per cent. of 15.84 pounds equals 11.88 pounds soluble matter, will go off in the juice to the boiling house, and the bagasse will then contain 12 pounds fibre, 15.84—11.88=3.96 soluble matter, and 72.16—54.12=18.04 water. Now this bagasse receives a shower of hot water of, say 10 pounds; this dilutes the juice in the bagasse, and puts it in the following condition: 12 pounds fibre + 3.96 soluble matter + (18.04 + 10 = 28.04) water. 3.96 plus 28.04 is the diluted juice in the bagasse. Now we will see how much sugar is contained in this juice expressed in per cent. 28.04 + 3.96 = 32 pounds of diluted juice. This 32 pounds diluated juice con-

tains 3.96 pounds soluble matter, therefore 100 pounds contain $\frac{3.96 \times 100}{32} = 12.37$ pounds, or per cent.

As the Brix. spindle reads the per cent. of soluble matter in solution, we can say instead of 12.37 per cent., 12.37 deg. Brix., and I shall use this term hereafter.

This macerated bagasse is fed into the second mill; this will, I assume, extract 60 per cent. of the diluted juices in the bagasse, which will give these results:

60 per cent. of 3.96=2.376. pounds, go to the boiling house, and the bagasse contains:

12 pounds fibre, 3.96—2.376=1.584 soluble matter.

60 per cent. of 28.04=11.216. pounds water=12.8 pounds juice.

Treating this bagasse again with 10 pounds of water, we have the new conditions thus:

12 pounds fibre 1.584 sol. matter + 11.216 + 10 water, or 12 pounds fibre + 22.8. pounds juice.

This juice having been diluted, has the following Brix.:

$$\frac{1.584 \times 100}{22.8} = 7.039 \text{ Brix.}$$

This enters the third mill, which extracts, I assume again, 50 per cent. of the juice; 50 per cent. of 1.584=0.792. pounds sol. matter goes to the boiling house, and the bagasse is like this:

12 pounds fibre, 0.792. sol. matter, 10.608 water, 12 pounds fibre + 11.4 pounds juice. This bagasse goes to the fire room as fuel, and contains as loss of pure sugar $\frac{0.792}{100} \times 86 = 0.6811$ pounds of sugar to every 100 pounds of cane.

In comparison to total solubles and expressed in per cent., we have every 15.84 pounds soluble matter, we lose 0.792. lbs.; therefore, out of 100 pounds we lose $\frac{100 \times 0.792}{15.84} = 5$ pounds.

Therefore we extract 95 pounds out of every 100 pounds of soluble matter.

To account for the sugar which has been exposed to the milling and maceration process, we have:

Exracted sol. matter—		
Crusher and 1st mill	11.88	lbs.
2nd mill	2.376	"
3rd mill	0.792	"
Lost in bagasse	0.792	"
	15.840	

As you see, the sugar has all been accounted for, but this cannot be done in practice, because there are losses everywhere, and some of these losses are hard to account for.

This example only has given an outline of the process, but I hope that it has been clear enough to serve as a foundation

in some future time to go into the more delicate determinations concerning extraction of juice from cane.

The figures taken are entirely arbitrary, but are not far from those found in actual work on these Islands.

Before concluding I would like to say that the 20 pounds of water used in maceration represents 22.74 per cent. of the total juice, because 20 : 88 : 22.74 : 100.

SUGAR AND ITS IMPURITIES.

BY DR. C. A. KERN.

The varying influence of impurities above or below a certain standard is clearly shown in the buying and selling prices of raw sugars. The polarization of a sugar determines the percentage of pure saccharine matter contained therein; if the polarization is low, the quantity of impurities is large, and vice versa. This effect of the proportion of impurities on the value of sugars is not in simple relation. Whereas a high-polarizing sugar increases in value by a certain fraction for each point above a standard degree of polarization, a sugar containing more impurities decreases in value by a much larger fraction for each point below the standard. The following table of trade allowances will serve for illustration:

Centrifugal Sugars, basis 96° Polarization.

Cost and freight in cents, per pound.	Duty paid in cents, per pound.
Each degree above, 1-32 c. added	1-16c. added.
Each degree below, 1-16c. subtracted	1-10c. subtracted.
Below 94°, 3-32c. subtracted	1-8c. subtracted.

Muscovadoes, basis 89° Polarization.

Cost and freight in cents, per pound.	Duty paid in cents, per pound.
Each degree above, 1-32c. added	1-16c. added.
Each degree below, 1-16c. subtracted	1-10c. subtracted.
Below 84°, 3-32c. subtracted.	1-8c. subtracted.

Molasses Sugar, basis 89° Polarization.

Cost and freight in cents, per pound.	Duty paid in cents, per pound.
Each degree above, 1-32c. added	1-16c. added.
Each degree below, 1-16c. subtracted	1-10c. subtracted.
Below 84°, 3-32c. subtracted.	1-8c. subtracted.

The so-called raw sugars come to market in form of crystals of varying size. These crystals nowadays consist of pure sugar (formerly a little globule of molasses syrup was sometimes enclosed in the crystal, caused by faulty boiling), but the surface of the crystals is coated with the molasses or syrup, out of which they are crystallized. The molasses is also sometimes held by an agglomerated number of crystals of varying size. Considering that one pound of coarse crystal-

lized sugar has an approximate crystal-surface of 1½ square yards and a fine crystallized sugar a surface up to 3½ square yards the difference in the quantities of adhering molasses is easily explained. The coarse crystals are generally obtained from the first products of the sugar juice, and the fine crystals from the later products; consequently, the impurities of the latter are greater in quantity and more deleterious in quality. The impurities of the lower products have a greater tenacity and are more difficult to remove from the crystals than the impurities of the first products. The adhering sugar liquor and molasses contain the greater part of the impurities. They consist, partly of some invert sugar, a mixture of glucose and levulose or fructose. By the decomposition of these latter, and their chemical reaction with other materials, a great number of other impurities are formed and contained in the molasses, such as the following organic acids: Glycolic acid, acetic acid, formic acid, propionic acid, butyric acid, erythrit acid, saccharic acid, melassinic acid, malic acid, etc., etc. These organic acids with alkalies form salts which are more or less soluble in water and in molasses syrup.

Other substances contained in the adhering molasses are nitrogenous bodies, such as the xanthine bases, chiefly guanine. But the raw cane sugars contain less of these bases than the raw beet sugars, in which is found a great amount of the amido acids, such as leucin, asparaginic acid, asparagine, glutaminic acid, and the bases: lecithine, cholin, betain. The presence of these last substances among the impurities makes it difficult to refine by the old process with the use of charcoal alone, as the peculiar smell and taste of this substance is difficult to remove.

The mineral impurities, better known as the ash, found dissolved or chemically bound in the molasses, contain bases mostly bound to organic acids. The bases are, lime, potash, soda, magnesia, iron. Other chemical impurities and combinations are with chlorine, phosphoric acid, silicic acid, sulphuric acid, etc., etc.

Owing to its sticky and hygroscopic nature, the adherent molasses takes up and holds as impurities other materials, as sand, dust, fibres, strings, etc. In the raw cane sugar are found residues of bagasse, and on account of poor defecation and filtration in the manufacture of raw sugars, pectin substances, albumen and fibre are present. The accidentally mixed impurities are very numerous, and the space for this article is too limited to consider them all.

The refiner generally divides the impurities into two classes: those soluble in water and those insoluble therein. The latter, such as fibres, sand, straw, etc., can easily be removed by filtration, but the soluble impurities, comprising a class of numerous bodies of chemical character, are with difficulty or not at all to be removed from a sugar solution. In the old sugar-

refining process the raw sugar is dissolved in water, and with it the impurities contained in the adherent molasses. The so-called washing process, wherein the raw sugars are washed in centrifugals with water, sugar liquor or steam, gives the same result, as the impurities are carried from a greater body of sugar to a smaller one, without removing them entirely.

As before mentioned, the soluble impurities consist of a great variety of chemical combinations. By dissolving in water, heating with steam and boiling, they—especially the organic acids—form new combinations with lime, which is generally used in refineries, and also with the salts, which are derived from the evaporation of the great quantity of water used in the old process. These newly formed salts are partly soluble in water; for instance, malic acid forms with lime a salt, which is soluble in water; succinic acid reacts with lime with the same result. These acids and salts are very stable and are very difficult to remove from a sugar solution. The free organic acids destroy sugar in solution, and more freely when heated. The sugar, as saccharose, is converted into invert sugar, which is a mixture of glucose and fructose. This is one phase of the injury done by the impurities.

By virtue of the presence of these soluble impurities in all their different combinations, the so-called molasses is formed, which prevent a certain amount of sugar from crystallizing, and is thus lost to the refiner as white sugar. These losses are an important factor in the selling and buying of raw sugars, and has resulted in a certain system for their valuation. Through many years of experience of the old refiners, it it was found that the mineral substances, the so-called ash, prevent about five times their amount of sugar from crystallizing, and that invert sugar prevents one to two times its own amount from crystallizing. Thus, if a raw sugar has a polarization of 94 per cent., ash 1.5 per cent., invert sugar 0.5 per cent., the mineral substances would render 7½ per cent., and the invert sugar 1 per cent., uncrystallized; or, the above sugar of a percentage of 94 would give to the refiner only 85½ per cent. of marketable sugar. Even such a result is doubted. A well-known authority on sugar said at the last International Congress of Chemists in Berlin that these results are difficult to attain.

I mentioned above that under the old process 85½ per cent. of sugar is obtained from 94 per cent. of raw sugar of above analysis. This is not all white granulated or standard, for a good percentage is represented by the so-called soft sugar, such as Columbia, Phenix, Empire A, C, D, and according to number 1-2-3-4-5-6, etc. These sugars are only partly refined sugars, having more or less of the soluble impurities contained in the adherent molasses. They are the residues of the old imperfect method for refining sugars, and could not be made

into white granulated sugar, except at a great loss. The new processes are working on a more scientific basis. Their first step is to remove all the soluble impurities from the sugar crystals, without injuring the crystals and before dissolving it in water. For instance, if we take a sugar of the above-mentioned analysis, and remove the soluble impurities, vide ash and invert sugar, a sugar of about 99.3 to 99.5 per cent. is the result. The remainder consists of insoluble impurities, such as straw, fibres, etc., and can be removed by filtration when the sugar is dissolved. The recrystallization of this purified sugar is easy.

More profitable results can be obtained in treating low-grade sugars, as muscovado and molasses sugars of a polarization of 80 to 89, in that the impurities are quickly removed and a sugar of 99.5 per cent. is the result.

To illustrate the great importance of the influence of soluble impurities on the sugar industry of this country, the following will serve: The consumption of sugar in the United States for the last year was, in round figures 2,600,000 tons. Taking a 4 per cent. loss in the refining of sugar as a low average, as explained above, the loss would amount to 104,000 tons of white sugar, which, at the present price of $4.90, would be valued over $11,000,000.—[Fed. Rep.

DISAPPEARANCE OF REDUCING SUGAR IN SUGAR CANE.

The occurrence of reducing sugar in sugar canes and sorghums has important relations to the metabolism of the plants. Presumably the carbohydrate which is finally formed in the chlorophyl cells of these plants is some variety of starch, probably a soluble variety, since starch granules as such would find obstructions to circulation in the return currents from the leaves to the body of the plant. During the early stages of growth it has been shown by repeated analyses that the proportion of reducing sugar to sucrose in the juices of the sugar cane is very high. In Louisiana where the canes are harvested necessarily before growth is complete, the average quantity of reducing sugars in the juice is one per cent or more. In the tropics at the time of harvest the percentage of reducing sugars is very much less, usually less than one-half of one per cent. These facts show beyond doubt that the highest relative value of reducing sugar to sucrose is in the earlier stages of growth and the lowest proportion in the matured stages. Theoretically, then, we might expect that at a certain period representing the complete and perfect maturity of the plant the reducing sugar would disappear. The further phenomenon, however, has also been observed, namely, when the reducing sugar is reduced to a minimum on approaching maturity, any deterioration in the plant due to long

standing, over-ripeness, injury from frosts or otherwise, tends to reverse the order observed during the growing period, and to increase the percentage of reducing sugar at the expense of the sucrose. This reversibility of enzymic action has been well established in the case of the carbohydrates.

If the sugar cane, therefore, be allowed to normally grow and mature there is a certain time in its history, as above mentioned, when the proportion of reducing sugar is at a minimum. The theory above outlined receives confirmation in some analytical data secured in this bureau recently on samples of sugar cane grown in Florida. Four samples were obtained which were all harvested at the same time, namely, the middle of May, 1903. The canes were grown by W. H. Abel on Terra Ceia Island, Manatee county, Florida, about 150 yards from salt water. The soil is sandy to a depth of from 12 to 18 inches, with a thin stratum of chocolate colored subsoil resting on clay which carries some pebble phosphate. The particular samples under question were grown on the edge of a field next to timber, and being in the outside row did not get much cultivation and practically no fertilizer. The samples were cut seventeen months from time of planting. The analytical data obtained from the four samples are as follows:

COMPOSITION OF THE JUICE.

Density.	Sucrose.	Purity.	Glucose.
21.0%	19.0%	90.5	None.
20.8%	18.7%	90.0	None.
20.4%	18.0%	88.2	None.
21.7%	19.8%	91.2	None.

These are the only samples of sugar cane ever analyzed under my supervision which did not contain a greater or less quantity of reducing sugar. At the end of two minutes boiling of the juices with an alkaline copper solution there was no trace whatever of any reduction. On longer continued boiling and after allowing to stand over night there was a mere trace of reddish precipitate due doubtless to the inversion of a part of the sucrose.

A great many of the canes grown on this field produced tassels, but Mr. Abel did not state in his description whether the four canes sent had tasseled or not. The presumption is that they had. We have in the above what appears to be an example of a complete cycle of growth in the sugar cane, probably a cycle which would not be realized farther south. Evidently the cool nights of the winter had helped to complete the period of growth while at the same time they prevented a beginning of the second growth which would certainly have reversed the metabolic activities within the cane and secured an inversion of a part of the sucrose.

It is probable that the meteorological conditions which produced so complete a growth do not often obtain and the above

data are therefore of interest, both from a chemical and physiological point of view. The analyses were made in the sugar laboratory by Mr. A. W. Bache. H. W. WILEY.

Bureau of Chemistry, Department of Agriculture, Washington, D. C., June 9, 1903, in Louisiana Planter.

THE SUGAR BEET IN THE UNITED STATES.

BY WILLIAM R. LIGHTON AND CHARLES E. DUFFIE.

The world's sugar crop for the manuacturing year 1901-02 was in excess of ten and three-quarter millions of long tons; or, in round numbers, twenty-four billion pounds. If this were loaded upon wagons, two tons to each, and the wagons set in close order, the train would encircle the earth. Of this great quantity more than two-thirds was made from sugar beets.

The United States cuts a very poor figure in the sugar industry. Our annual consumption is sixty-eight pounds per capita, a total of two and a half millions of tons—or, approximately, one-fourth of the world's supply—but, if we exclude our island possessions from the reckoning, our domestic production is considerably less than one-twentieth of the world-crop, and less than one-fifth of what we consume. For the fiscal year ending June 30, 1901, we imported more than two million one hundred thousand tons, of the value of one hundred and twenty-two million five hundred thousand dollars. Of this quantity Cuba furnished twenty-seven per cent.; the Dutch East Indies, nineteen per cent.; Germany, eighteen per cent.; and the rest of the world, the remainder, in small and scattered portions. Including as "domestic" the output of Hawaii, Porto Rico and the Philippines (which exceeds that of the United States proper), we must still import annually upward of ninety million dollars' worth of sugar to supply the home demand; and the demand is increasing at the rate of nearly five per cent. a year. This is a condition out of keeping with our achievements in other industrial fields; it means that we have not lived up to our opportunities.

Within very recent years, however, a change has set in, which will put us in a better position. The sugar-beet is to redeem us from this unseemly dependence; and there is small doubt that, in the course of time, it will give us dominance in the world market. For the manufacturing year 1901-02, our factories produced about one hundred and eighty-six thousand tons of beet sugar. As compared with the volume of product of several European countries (Germany, 1,800,000 tons; Austria and France, 1,000,000 tons each), this showing is insignificant; yet it was an increase of 140 per cent. over the preceding year, and was equal to about 60 per cent. of our cane sugar. So recently as 1888 the year's manufacture was less than one thousand tons. Against this two hundredfold increase in four-

teen years, it is well to note that in the last twenty-one years our manufacture of cane sugar has increased but 155 per cent.

The genesis of the beet-sugar idea was, in a sense, fortuitous. The Napoleonic wars cut France off from her normal supply of cane sugar and made it necessary to discover a substitute. This was found in the beet root, which until that time had no recognized value. This is but another link in the endless chain of apparent deprivations and hardships which has lifted the human race to its present industrial place and power. From crude beginnings a century ago, the extraction of sugar from the beet has become one of the staple industries of France; the Germans have borrowed the idea and applied it with even greater success; and it will soon be one of the mainstays of both agriculture and manufacture throughout the civilized world.

Although the successful manufacture of beet sugar in the United States has developed within the last fourteen years, experiments were begun as early as 1830, when a Philadelphia company made the initial trial, but failed of results. In 1838, at Northampton, Mass., a second attempt was made, and about one thousand pounds of sugar of good quality was produced; but from a practical point of view, this experiment, also, was a failure. Indeed, there was nothing but a long series of failures, until at last a factory was built at Alvarado, California, on a scale sufficiently large to render production profitable. Once success was attained there, the industry worked its way gradually eastward from the Pacific coast to the Hudson valley. Data for the tenth census, gathered in 1879, showed four factories then in operation, with a combined capital of only three hundred and sixty-five thousand dollars. Ten years later there were but two. To-day there are upward of forty, employing an aggregate capital of about thirty million dollars; and many others are in course of construction. The great stimulus came only about five years ago, when success was so fully assured that money could be secured for building the large plants necessary. Michigan affords a striking example of this progress. Prior to 1898 that State made not a pound of her sugar, while now she has nearly a score of factories in active operation, and supplies practically all the sugar consumed by her people. Prophecy is an uncertain business; but it seems probable that the next five years will witness an even greater development.

The apparent tardiness of the United States in effecting substantial results must not be charged wholly to the reluctance of capital. There was much to learn, and many obstacles were to be overcome, even after factories were built, before the industry could be said to be established. The pioneers paid very dearly for the experience from which the future is to profit. It was easy enough to import the theory

of manufacture from abroad, where success had been attained; but the practice had to be worked out slowly on our own ground and at our own cost. In a broad sense it may be said that the industry is still in an experimental stage in the United States.

The primary problem is purely agricultural. Given a factory ideally situated, it must fail unless the farmers of the immediate neighborhood can be induced to devote their land and time to the growth of beets. But the old-fashioned American farmer is proverbially a conservative fellow, clinging tenaciously to time-honored traditions and methods, openly scoffing at a new field product or a novel idea. He knows a few simple rules for working the soil, which are supposed to fit all crops, all places and all conditions. Perhaps Nature has been too kind to him, in giving him abundant harvests of his few staples, while largely relieving him of the necessity for enriching his fields with that best of all fertilizers—brains. He has wasted more opportunities than he has used. In this his lot is markedly different from that of his European brethren, whom necessity compels to husband their resources to the uttermost and to turn them to fullest account. They are not favorites of a happy fortune, but men trained by tradition and experience to the hard work of farming under adverse conditions. Until very recent years, when the ranks of the American farmers were recruited from the trained men of the agricultural college class-rooms, but a very small fraction of the experimental work with sugar beets was done by our "practical" farmers; it was carried on in part by the projectors of factories, in part by State experiment stations, and in large part by the Federal Department of Agriculture.

The experience of European growers is only partially serviceable here. The breadth of our continent affords an almost infinite variety of soils and climatic conditions, many of them widely different from those of the Old World. As an instance: It remained for our people to initiate the growing of beets on arid lands with the aid of irrigation; and, in this field, results have been attained surpassing anything in the past. Whether the crop can be grown to advantage in any given locality must be determined by actual trial. These trials have been so far prosecuted that the "sugar-beet belt" is now quite clearly marked out, extending from the Hudson valley westward through southern Michigan, northern Illinois, Iowa, Nebraska, Colorado and Utah, on to the Pacific Slope of California, and including many scattered parts of the so-called "desert regions." Yet, notwithstanding this advance in knowledge, the farmers are slow to be convinced. In the year 1899 there were but one hundred and ten thousand acres planted to this crop in the entire country; in 1902 the supply of beets was equal to only about two-thirds of the nominal capacity of the

factories in operation; few or none of the factories were fully supplied.

This is a special crop, and it requires special treatment at every stage of culture, from plowing to harvesting. Almost every day of the growing season is a crisis, which can be met only by unremitting attention. The ground must be thoroughly and deeply prepared; seeding must be done with exact care; and the appearance of the young plants is to be followed by laborious "bunching," thinning, cultivating, hoeing and weeding—there is no day of leisure until the crop is gathered and marketed. Most of this field labor must be performed by hand, while the laborers go along the rows on "all fours." It is severe, of course, and not at all like standing by and watching a field of wheat come to maturity; and this severity makes it difficult to secure field-hands, as well as causing the landowner himself to regard the crop with some aversion. But results are eloquent, and will, in time, overcome all such opposition.

The average cost of growing and marketing sugar-beets, under normal conditions, is approximately thirty dollars per acre. The average yield throughout the country in 1901 was nine and six-tenths tons per acre. This average, however, is much below the results secured by the more intelligent growers; and the successful farmer is always he who will not be satisfied with general averages—he wants to excel, and the desire is father to accomplishment. The average of those fields which receive proper care shows a yield of twelve tons per acre. The price paid at the factories was from four dollars to four dollars and fifty cents per ton, giving a gross return of from forty-eight dollars to fifty-four dollars per acre, and a net profit of from eighteen dollars to twenty-four dollars. As against these figures, it is notable that the average gross returns from all cultivated lands in the country was less than ten dollars and fifty cents per acre, and of all lands devoted to cereal crops but eight dollars and two cents per acre. In some cases the gross value of beet crops ran as high as seventy-five dollars to one hundred dollars per acre, the difference being a premium on brains.

The prevailing practice of the factories is to make contracts with growers at the beginning of the season, the contracts stipulating the number of acres to be planted and the price to be paid for the crop, this price usually varying according to sugar content and purity. Quality is the first requisite; the mere size of the beets, by which the beginner may be lured, is wholly secondary. Because of this and other liabilities to error, it is also the custom of the factories to employ field superintendents—experienced men who, according to the terms of agreements with farmers, have general direction of the field work, giving needed instruction concerning the successive steps in culture and prescribing the time and manner

of harvesting. The service which these superintendents render costs the farmers nothing, while it is invaluable in educating them to proper methods. Thus, gradually, the unreasoning prejudices of cultivators are being removed.

As already indicated, it is in the irrigated arid regions that sugar-beet culture has been attended with the most satisfactory results. There the conditions of growth and maturity are more subject to control. Once the beets have ripened and stored their sugar (a process which demands abundant sunlight and little rainfall), it is of the utmost importance that they be harvested before an untimely rain starts them to new growth, which will often totally destroy their sugar and render them valueless. In the non-irrigated, humid regions these rains cannot be guarded against; but where irrigation is practiced, the water is distributed just when and where it is needed, giving the grower mastery of the situation. The average sugar content of beets grown in the humid districts does not exceed fourteen per cent.; while, in the inter-mountain valleys of Colorado, crops have been grown, under ditch, containing twenty-seven per cent. of sugar of a high degree of purity. This improvement in quality increases the profits of the grower and greatly decreases the cost of extracting the sugar at the factory.

Within twenty years the cost of growing sugar-beets in Germany has been decreased fifty per cent. through various improvements in stock and methods; and American ingenuity will doubtless effect further substantial reductions. Here, as nowhere else, machinery is superseding hand labor in the care of all important crops; and this will occur in beet culture. Already a notable beginning has been made.

Although this is unquestionably one of the most profitable of field crops, the advantages of its culture are not to be measured wholly by the immediate returns in dollars and cents. Thorough, intensive cultivation of the soil is an art of which the American husbandman knows far too little, and beet-growing is admirably calculated to convince him of its utility. Deep plowing, frequent hoeing and careful weeding not only insure the beet crop, but also vastly increase the productive power of the land in after years. Where crops are properly rotated, gradually the entire farm is brought to a high state of perfection. A few successful years of beet-growing, with the realization of excellent profits, arouses the farmer to an appreciation of the benefits of special education for his work with other crops.

Sugar beets cannot be profitably shipped over any considerable distance; so the factories must be built in the centers of the beet-growing districts. Here and there in the western States these huge establishments may be seen standing on the open prairie, surrounded by the cottage homes of the workmen. This necessitates the transportation of machinery, and

sometimes of building material, for many hundreds of miles, adding greatly to the first cost of construction. Under the best of conditions a large capital must be invested, the special machinery being the largest item of cost. In 1900 the average of all factories showed an investment of one thousand and ninety-seven dollars for each ton of daily capacity in beets; the average daily capacity was six hundred and sixteen tons, so that the average plant represents an investment of more than six hundred and seventy-five thousand dollars, of which four hundred and sixty-five thousand dollars was for machinery. A few years ago this large equipment was bought in Europe; now it is made at home.

The first question which determines the location of a factory is, of course, the adaptability of the surrounding soil to beet-growing. There must also be an abundant supply of pure water; limestone must be near at hand; fuel must be available, and transportation facilities must be adequate. When the factory is completed, there is the further problem of labor. About two hundred men are employed in the average establishment. As a matter of course, the great majority of these are at first wholly unskilled in their work, and profitable operation is hardly possible until they have gained some practical experience. There are many other inevitable delays, all entailing expense. The sugar-making season follows the beet-harvest, and lasts for but a little over three months. For the remainder of the year the plant is idle, save for such work as is required in making repairs and experiments and evolving improvements in methods, suggested by the experience of the campaign just closed. Most of the workmen are released at the end of the manufacturing campaign; but, in the interval between that and the next, they can always find profitable employment in the beet fields. There is never a dearth of work in the neighborhood of a sugar factory. In 1900, when Michigan had thirteen factories in operation and sixty-six thousand acres planted to beets, there was a total of one million five hundred and forty-five thousand days' labor expended upon the crop in the fields, the pay-roll for this labor aggregating two million two hundred thousand dollars. Employment was given to thirty-four thousand men and six thousand horses.

The cost of beet-sugar production varies considerably in different parts of the United States, as labor conditions, cost of materials and quality of beets cannot be uniform; and the size of the factory has an important effect. An average of results in the Michigan factories for 1900 shows that a ton of beets yielded two hundred and ten pounds of refined sugar; and all operating expenses, including interest on investment and depreciation in value of plant, were nine dollars and eighty-three cents per ton of capacity in beets, giving four dollars and sixty-eight cents as the cost of producing one hundred pounds

of sugar. That was, perhaps, a fair average for the country at large that year. The cost of operation is being decreased from year to year; eventually, it will be reduced one-half.

The waste of by-products is one of the greatest present concerns of the manufacturer. From one-fourth to one-third of the sugar content of the beets cannot be recovered by the processes now in use, but remains in the form of an acrid molasses, for which no particular commercial place has yet been found. Slight use is made of it in the manufacture of alcohol, vinegar, shoe-blacking, and other minor products; some is restored to the land as fertilizer; but far the greater part remains unused, a large loss and a serious inconvenience in handling. Further discovery will doubtless lead to the saving of a larger proportion of the sugar, and also give value to the crude molasses; but today it is only an incubus. The same is true concerning the beet-pulp, from which the juice has been expressed. This pulp has a distinct value as a food for sheep and dairy, or beef cattle; experiments have proven its value for this purpose to be about one dollar and fifteen cents per ton; yet stockmen are slow to adopt it. As it represents fifty per cent. of the weight of the beets, its accumulation at the factories is often a serious annoyance. Most of the establishments find it necessary to pay for having it hauled away. At Leavitt, Nebraska, is a five-hundred ton factory, built by the stockholders of a large cattle company, whose feeding barns are near by; and here the entire product of pulp is consumed by four thousand cattle and thirty-five thousand sheep. This saving constitutes a very important item in the economical administration of the plant.

The multiplication of sugar manufactories has social effects that are far-reaching. Lying in rural neighborhoods, they afford a powerful stimulus to the ambition and thrift of the people, furnishing an ever-present market for an important crop, and making a strong bond between the manufacturing and agricultural interests of the nation. Local railroading, banking and merchandising are greatly strengthened; the first steps in scientific agriculture are taken; local political affairs gain much in stability from the new industrial poise; the character of the farms is vastly improved; other dependent industries grow up in the immediate neighborhood, such as those for curing, canning and preserving fruits, strengthening the markets for other farm products—in short, the sugar factory is invariably the center and heart of a prosperous and self-contained community. This must always be true in any society, large or small, where skill is at a premium, where brains have a firm place in the popular life.

Conservatives have voiced the fear that beet-sugar making may be overdone. It seems a groundless fear. To supply our own present demand for domestic consumption would necessitate the building of five hundred factories, each with a daily

capacity of five hundred tons of beets. We shall come to this in due time; but it will not be an overdoing. An expenditure of two hundred and fifty million dollars will be required to build and equip these factories; their operation will entail the annual cultivation of one million seven hundred and fifty thousand acres of beets, for which the growers will receive eighty-five million dollars; the outlay for operating expenses of the mills during each three or four months' campaign will be about one hundred and thirty-five million dollars, of which twenty million dollars will be paid for factory labor. Better still, we shall be independent of the outer world for our supply of one of the prime necessaries of life; and, best of all, there will be five hundred sturdy, self-sustaining and well-to-do American communities scattered abroad between the two oceans. Few of what may be called our future industries promise such widespread and substantial results.

Beet sugar has had to make its way in our home markets against great odds of popular prejudice. It would be hard to say why, but our people early conceived the notion that beet sugar was inferior to cane; they have long insisted upon having "imported" sugar, ignorant of the fact that, in getting what they demanded, they were often buying German or French beet sugar. To offset this folly, American manufacturers are today compelled to sell their product at ten cents less per hundredweight than the price paid to foreign makers. As a matter of fact, chemistry can distinguish no difference between beet and cane sugars. In time this curious conceit will wear away.

Whatever the solution of the Cuban problem, it will mean neither life nor death to beet sugar manufacturing in America; it is but a vexatious incident. The industry will fight its way to a great ultimate success. That is written on the wall. It is too strong to die a-borning, even though cradled in adversity. What better solution of the Cuban question, and of every other like it, than to cut off the cause of contention? We shall make our own sugar in our own factories on our own soil. In the last analysis, the future of the industry is safe, now that our own capital and our own energy are indissolubly identified with it. The outcome is in our own hands.—Cosmopolitan Magazine.

IS SUGAR HEALTHFUL?

Sugar is getting into the hygienist's good graces. Instead of being frowned upon as being the cause of indigestion, bad teeth, and general ill-health, it is now regarded as a valuable food-substance by most physicians. Not by all, however, for, as we are informed by a writer in the Drogistische Rundschau, while some of them maintain that sugar is of great service to the human body, strengthening the digestion and preventing

undue acidity, others declare that even its moderate use is injurious to both the stomach and the teeth, while its excessive use develops diabetes. Says the author of the article just mentioned, which is translated for the National Druggist (July):

"Old and famous doctors, like Hufeland and Heim, declare that 'a moderate use of sugar stimulates digestion and prevents fermentation in the stomach, while an excessive indulgence in the article has an injurious effect on the digestive faculties, as it causes the formation of an excess of lactic acid, which makes itself apparent in the secretions, especially in the saliva, and in this manner produces an injurious effect on the teeth.

"Latter-day physicians, those representing the latest phases of medical knowledge, declare with great positiveness that 'sugar causes acidity of the stomach only when ingested in small quantities into a stomach already acid or inclined to acidity, when the lactic acid fermentation seizes upon it and carries it along with it. If, however, the sugar is used in larger quantities it overcomes the fermentation and stops it.'

"The latest investigations have in truth demonstrated that lactic acid fermentation is stopped by an excess of sugar; but, to the disappointment of pie-eaters and bonbon devotees, it must be stated that this effect is produced only when the substance is absolutely pure. In this condition it seems to make no difference whether the sugar be eaten solid, in the shape of lumps, or dissolved in pure water. Sugar excites the secretions of the stomach, increases digestion of albuminous matters and of nutritives containing iron and lime, a fact which proves that under proper conditions sugar is a remedy against anemia, chlorosis, and in scrofula.

"This explains the love of a great many children for sugar in the lump, who afterward, as they grow older, avoid plain sugar, or sugar by itself, almost entirely. It seems to be a sort of instinct with children with weak bones and thin blood. As early as 1878 Dr. Bockel recommended, in his writings, sugar as the best and most powerful remedy in rachitis ('rickets'). According to the theory advanced by him, the sugar given in such cases sets up an alcoholic fermentation, which overcomes the lactic acid present in excess and thus prevents the escape of the bone-building salts."

According to the writer, the idea that sugar causes bad teeth is an altogether mistaken one. The teeth of the negroes in the tropics are dazzlingly white and sound. On sugar plantations in Cuba, Louisiana and elsewhere, all negroes run down with labor or sickness grow sleek, fat and strong again on the return of the sugar harvest solely by chewing the cane. Englishmen and Americans eat more sugar than the French and the Germans, and yet they have better teeth than the latter. He goes on to say:

"After participating in many kinds of food, sugar seems to act as a digester, and that heaviness often felt after a hearty meal is frequently relieved by drinking a glass of sugar-water. The famous Hufeland, in his book 'Makrobiotik' (i. e., on long life), sings a hymn of praise to sugar, and recommends plenty of sugar to all who have to eat coarse, heavy food. It is better, he states, for lean persons than fat ones.

"When we find that cake-bakers and millers habitually have bad teeth it is natural to charge the fact to the use of sugar or of flour. Rather ascribe it to the lack of care of the teeth, habitual with those people, which permits particles of food to remain between the teeth and thus further decomposition. If they used the brush frequently and properly they would have as good teeth as anybody.

"In old times our confectioners, bakers, etc., did not employ sugar in their sweet wares, but honey, whose antiseptic properties were known even in remote antiquity, and the Egyptians, Greeks, etc., frequently used it as an application to serious wounds. For that matter, as late as the seventeenth century, our ancestors used sugar as an application to wounds. The practice, however, fell into neglect and was forgotten until only recently prominent surgeons are again bringing the substance into use. Dr. Lucke, for instance, professor at the University of Strassburg, recommends it in gangrene, and had used it with excellent results.

"The Frenchman, Claude Bernard, has demonstrated that the normal sugar content of the blood immediately commences to rise whenever any disease or injury to the organism commences to grow better. In this case a blood rich in sugar seems to exert an influence on the reparative action. This condition of the blood lasts until the health is restored or until the source of supply (of sugar) is cut short. Normal and healthy blood always contains sugar, which is derived from all nutritive foods and has absolutely nothing to do with the consumption of pure sugar. That a too great indulgence in sugar, by itself or mixed with other things, can have a bad effect and cause sickness is not to be denied, but that its use, either in small quantities or large, can cause diabetes cannot be too strongly denied. Such an idea could be conceived or find defenders only from the fact that the original cause of that too frequent disease has, up to the present, eluded investigation and remains a mystery.

"Finally, we can assert that the healthiness of sugar is no longer disputed by educated physicians. That it is not only an article of nourishment, but a beneficent one, is demonstrated by the fact of the constant growth of its employment. In A. D. 1700 all Europe used about 100,000,000 pounds of it; in 1870 this had reached 4,000,000,000 pounds, while statistics show that from the end of August, 1900, to February, 1901, 2,000,000,000 pounds of beet sugar alone has been consumed."
—The Literary Digest.

THE MEXICAN SUGAR INDUSTRY.

Mexico is in many respects an ideal sugar producing country. In many parts of the Republic the climate and soil are favorable to the growth of the sugar cane, and not only is the cane itself very rich in saccharine matter, but replanting every year is unnecessary. As many as eight or ten crops being gathered in Mexico before new seed need be planted. There is no reason, so far as natural conditions are concerned, why Mexico in certain parts should not rank with Cuba as a sugar producer, and that she is not yet an important factor in the world's market as a producer rather than a consumer is due to the fact that production has barely caught up with home consumption.

Though the Mexican sugar plantations best known to the outside world are in the lowlands along the Gulf coast, notably in Vera Cruz, sugar is successfully raised in many States of the Republic, including Tabasco, Jalisco, Morelos, Puebla, Sinaloa, Guerrero, Yucatan, Michoacan, Oaxaca, San Luis Potosi, Colima and others. These plantations are owned, and have been owned for generations, by old Mexican families, who possess immense tracts of land and have had an abundance of cheap peon labor. Their mills were primitive, though the cost of installing them in the inaccessible portions of the interior and undeveloped states was prohibitive for all except men of wealth, as wealth was reckoned in Mexico some years ago, and this same lack of transportation facilities added much to the cost of the product anywhere outside of the local market of each plantation. As a consequence, the country's production of sugar has heretofore been far short of the demand.

These conditions, and the further fact that the government, in pursuance of its general plan of protecting home industries, placed an import tax on sugar of 15 cents (Mexican) per kilogram, or 2.67 cents per pound in our currency, made the sugar industry a very profitable one, and in the recent awakening of the country to new life and activity much new capital has been invested in sugar plantations.

A large part of this investment has been made by local capital. The "sugar trust" in the City of Mexico, to which reference was made in the newspapers a few days ago as having effected a loan of $2,000,000, is a combination of three Mexican concerns, and is owned almost wholly by Mexican capital. The American sugar trust, so far as I am aware, has no interests in Mexico. But there are many Americans who have made investiments in Mexican sugar plantations individually, and in plantation companies. Several Louisiana planters, having got under cultivation practically all the available home territory, have extended their operations into the cheaper Mexican country, and a number of companies for the exploitation

of sugar plantations has been formed in Ohio, Indiana and other Western States in the past few years and are now beginning to produce.—Banker and Miner.

IRRIGATION WELLS IN AUSTRALIA.

Australia, with an area nearly equal to that of the United States proper, has a large arid interior. In fact, Andrew Carnegie, in a recent speech, referred to this great island as a mere shell of civilization around an empty interior. Nevertheless, much is being done toward the reclamation of parts of this arid area, and some irrigation is being done with deep artesian wells. One of these extends to a depth of 5,040 feet. the largest flow obtained was 6,000,000 gallons daily. The artesian area is said to be estimated at 264,600 square miles, or approximately one-tenth of the total area of the island.

SUGAR INDUSTRY IN QUEENSLAND.

REPORT OF THE REGISTRAR GENERAL FOR 1902.

(Continued from our September Number.)

Average yield of sugar crop in each of the great divisions for the past two years:

Division.	To Each Acre Crushed				Ton Cane to Ton Sugar	
	Tons Cane.		Tons Sugar.			
	1901.	1902.	1901.	1902.	1901.	1902.
Southern	12.69	5.46	1.21	0.56	10.43	9.80
Central	11.78	....	1.25	....	9.44	....
Northern	16.84	12.36	1.78	1.50	9.44	8.23
State	15.10	10.86	1.55	1.30	9.76	8.38

The tons of cane harvested to each acre crushed increased by 28 per cent. for the whole State; 57 per cent. in the South and 27 per cent. in the North.

The quantity of sugar made to each acre crushed dropped by 5 cwt. per acre for the whole State, the decreases for the South and North being 13 cwt. 5-6 cwt. per acre respectively.

It has been previously pointed out that in consequence of the dry weather a better return of sugar was obtained last year for each ton of cane harvested. This applied throughout the State. For whereas in 1901 it took for the whole of Queensland 9.76 tons of cane to make 1 ton of sugar, namely, 10.43 tons in the South, and 9.44 tons in the North, last year

the proportions were, for the State 8.38 tons; for the South, 9.80 tons; and for the North, 8.23 tons only.

The best yield of cane per acre was obtained at Ayr, 15.84 tons, followed closely by the most southerly district in the State—namely, Nerang, with 15.73 tons. The yield at Cairns-Douglas, Ingham-Morilyan, and Bowen, fell a little below these figures—namely, to 14.63 tons, 13.61 tons, and 13.58 tons respectively. The poorest yield was obtained at Bundaberg-Gin Gin—namely, 5.23 tons.

The best average return of sugar to the acre was secured at Ayr—namely, 1.81 tons; the poorest result obtained in the Northern division, where the average for the whole was 1.50 tons, was at Mackay, with a fraction of over 1 ton to the acre only (1.02). In the South, the small area at Nerang, 205 acres, gave the good average return of 1.67 tons, being double that obtained in the Logan and Maroochy-Gympie districts, and three times the yield of the Wide Bay groups.

At Ingham-Mourilyan the average required throughout the district to make 1 ton of sugar was only 7.63 tons of cane, and the greatest quantity needed in any district in the North was at Bowen, 8.85 tons, itself a low average. In the South, the least was at Nerang, 9.44 and the greatest at Logan, 11.96.

The sugar industry, for manufacture alone, and in addition to the requirements for cane production, gave employment to 1,663 hands, and has invested in it £2,583,689 of capital for premises and machinery.

Though much has been done to build up the sugar industry to its present dimensions, and the progress made as to improved methods of production and manufacture seems very considerable to those who were conversant with sugar planting in the State in its infancy, this progress has had a much larger relation to the manufacture of sugar than to the cultivation of the cane. Probably our best mills are equal to those of any country in respect to their appliances, but there is no doubt much has still to be accomplished in the field. Thorough cultivation, which embraces deep tillage, fertilization and irrigation, should be the planter's earnest aim; and something has been accomplished in this direction, more especially since the advent of Dr. Maxwell, the director of the Sugar Bureau, whilst much more remains to be done. Lime would appear to be a constituent much needed in the soil of many sugar districts, and in some instances is being procured and applied, nor have the benefits of green manuring been lost sight of.

Although the manure exported exceeds considerably both in quantity and value that imported, still nearly £4,000 worth was brought into the State, chiefly from New South Wales. That imported from England and Germany no doubt consisted of phosphates and chemical manure, and indeed the high

values placed on all the imports lead to a similar conclusion with respect to the greater part of them.

There were 3,274 tons, valued at £16,299, of different kinds of manures exported, an amount exceeding the imports by 2,951 tons in weight, and £12,545 in value. The 1,499 tons returned as manure (unspecified) were chiefly by-products of the boiling-down establishments, being of a somewhat less value than the bonedust—namely, not quite £4 13s. per ton, whilst the latter was worth some 12s. per ton more; the whole of the imports were of a value exceeding £11 per ton. No doubt the cost for freight is the important factor in the matter, and perhaps in some instances better results may be obtained by sending bulky manures from the State, and importing others that prove less bulky in transit; nevertheless, when fertilizers are so much in demand any export would appear to be a matter to be regretted.

The Geological Survey will make during the present year a series of investigations of artesian and other underground waters in the eastern United States, and these will embrace areas in all of the New England States. New York will have two problems investigated--the waters of Long Island, and this, in connection with the complete soil survey of that area by the Bureau of Soils of the Department of Agriculture, will give much useful information to farmers and others; the second relates to the occurrence, composition and economic value of the spring waters of the whole State. New Jersey will also have a complete survey for underground waters, and in the South, Georgia, Alabama, Mississippi, Kentucky and Tennessee will have their water resources of this nature examined. Arkansas, Missouri, Iowa, Minnesota, Wisconsin, Illinois and Michigan will also have certain areas investigated.—Forestry and Irrigation.

PLANTATION DIRECTORY.

ISLAND AND NAME.		MANAGER.	POST OFFICE.
OAHU.			
Apokaa Sugar Co.	*	G. F. Renton	Ewa
Ewa Plantation Co.	*	G. F. Renton	Ewa
Waianae Co.	***	Fred Meyer	Waianae
Waialua Agricultural Co.	*	W. W. Goodale	Waialua
Kahuku Plantation Co.	x*	Andrew Adams	Kahuku
Waimanalo Sugar Co.	**	G. Chalmers	Waimanalo
Oahu Sugar Co.	x	Aug. Ahrens	Waipahu
Honolulu Plantation Co.	**	J. A. Low	Aiea
Laie Plantation	x*x	S. E. Wooley	Laie
MAUI.			
Olowalu Co.	**	Geo. Gibb	Lahaina
Pioneer Mill Co.	x	L. Barkhausen	Lahaina
Wailuku Sugar Co.	**x	C. B. Wells	Wailuku
Hawaiian Commercial & Sug. Co.	x*	H. P. Baldwin	Puunene
Paia Plantation	x*	D. C. Lindsay	Paia
Haiku Sugar Co.	x*	H. A. Baldwin	Haiku
Hana Plantation	xx	E. K. BULL	Hana
Kipahulu Sugar Co.	x	A. Gross	Kipahulu
Kihei Plantation Co.	x*	James Scott	Kihei
Maui Sugar Co.	x**	J. R. Myers	Huelo
HAWAII.			
Paauhau Sugar Plantation Co.	**	Jas. Gibb	Hamakua
Hamakua Mill Co.	*x	A. Lidgate	Paauilo
Kukaiau Plantation	x	J. M. Horner	Kukaiau
Kukaiau Mill Co.	*x	E. Madden	Paauilo
Ookala Sugar Co.	**x	W. G. Walker	Ookala
Laupahoehoe Sugar Co.	*x	C. McLennan	Papaaloa
Hakalau Plantation	**	Geo. Ross	Hakalau
Honomu Sugar Co.	**x	Wm. Pullar	Honomu
Pepeekeo Sugar Co.	*x	H. Deacon	Pepeekeo
Onomea Sugar Co.	**x	J. T. Moir	Hilo
Hilo Sugar Co.	**	J. A. Scott	Hilo
Hawaii Mill Co.	x	W. von Graevemeyer	Hilo
Waiakea Mill Co.	*x	C. C. Kennedy	Hilo
Hawaiian Agricultural Co.	**x	John Sherman	Pahala
Hutchinson Sugar Plantation Co.	**	G. C. Hewitt	Naalehu
Union Mill Co.	*x	Jas. Renton	Kohala
Kohala Sugar Co.	*	E. E. Olding	Kohala
Pacific Sugar Mill	x**	D. Forbes	Kukuihaele
Honokaa Sugar Co.	x**	K. S. Gjerdrum	Honokaa
Kona Sugar Co.	xxx	E. E. Conant	Holualoa
Olaa Sugar Co.	xx*	F. B. McStocker	Olaa
Puna Sugar Co.	xx*	W. H. Campbell	Kapoho
Halawa Plantation	x*x	T. S. Kay	Kohala
Hawi Mill & Plantation	††	John Hind	Kohala
Puako Plantation	††	W. L. Vredenburg	S. Kohala
Niulii Sugar Mill and Plantation	*x	Robt Hall	Kohala
Puakea Plantation	*x	H. R. Bryant	Kohala
KAUAI.			
Kilauea Sugar Plantation Co.	**	A. Moore	Kilauea
Gay & Robinson	x*x	Gay & Robinson	Makaweli
Makee Sugar Co.	....	G. H. Fairchild	Kealia
Grove Farm Plantation	x	A. H. Smith	Lihue
Lihue Plantation Co.	x	F. Weber	Lihue
Koloa Sugar Co.	x	P. McLane	Koloa
McBryde Sugar Co.	*x	W. Stodart	Eleele
Hawaiian Sugar Co.	x*	B. D. Baldwin	Makaweli
Waimea Sugar Mill Co.	*	J. Fassoth	Waimea
Kekaha Sugar Co.	x	H. P. Faye	Kekaha

KEY.

*	Castle & Cooke (4)
**	W. G. Irwin & Co. (8)
***	J. M. Dowsett (1)
x	H. Hackfeld & Co. (9)
xx	A. S. Cleghorn & Co. (2)
xxx	McChesney & Sons (1)
*x	T. H. Davies & Co. (8)
**x	C. Brewer & Co. (7)
x*	Alexander & Baldwin (6)
x**	F. A. Schaefer & Co. (3)
xx*	B. F. Dillingham & Co. (2)
x*x	H. Waterhouse & Co. (3)
††	Hind, Rolph & Co. (1)

HONOLULU AGENTS.

STOCK	Capital Authorized	Shares Issued	Capital Paid up	Par Value	Last Sale
MERCANTILE					
C. Brewer & Co.	$ 1,000,000	10,000	$ 1,000,000	$ 100	390
SUGAR					
Ewa Plantation Company	5,000,000	250,000	5,000,000	20	20
Hawaiian Agricultural Co.	1,200,000	12,100	1,200,000	100	215
Hawaiian Com'l & Sugar Co.	10,000,000	100,000	2,312,750	100	46
Hawaiian Sugar Company	2,000,000	100,000	2,000,000	20	25
Honomu Sugar Company	750,000	7,500	750,000	100	105
Honokaa Sugar Company	2,000,000	100,000	2,000,000	20	14
Haiku Sugar Company	500,000	5,000	500,000	100	100
Kahuku Plantation Company	500,000	25,000	500,000	20	21
Kihei Plant. Co. Ltd.,	2,500,000	50,000	2,500,000	50	9½
Kipahulu Sugar Company	160,000	1,600	160,000	100	
Koloa Sugar Company	500,000	5,000	500,000	100	125
McBryde Sug. Co. Ltd.	3,500,000	175,000	3,500,000	20	3½
Oahu Sugar Co.	3,600,000	36,000	3,600,000	100	95
Onomea Sugar Co	1,000,000	50,000	1,000,000	20	34
Ookala Sugar Plantation Co.	500,000	25,000	500,000	20	10½
Olaa Sugar Co. Ltd.,	5,000,000	250,000	5,000,000	20	10
Olowalu Company	150,000	1,500	150,000	100	
Paauhau Sug. Plantation Co.	5,000,000	100,000	5,000,000	50	12
Pacific Sugar Mill	500,000	5,000	500,000	100	
Paia Plantation Company	750,000	7,500	750,000	100	250
Pepeekeo Sugar Company	750,000	7,500	750,000	100	
Pioneer Mill Company	2,750,000	27,500	2,750,000	100	95
Waialua Agricultural Co.	4,500,000	45,000	4,500,000	100	50
Wailuku Sugar Company	700,000	7,000	700,000	100	275
Waimanalo Sugar Company	252,000	2,520	252,000	100	160
MISCELLANEOUS					
Wilder Steamship Company	500,000	5,000	500,000	100	105
Inter-Island Steam Nav. Co.	600,000	6,000	600,000	100	120
Hawaiian Electric Company	500,000	5,000	500,000	100	100
Honolulu R. T. & Land Co.	1,000,000	P. 2,090 C. 7,910	1,000,000	100	100 81
Mutual Telephone Company	150,000	15,000	150,000	10	10
Oahu Railway & Land Co.	4,000,000	40,000	4,000,000	100	87½
Hilo Railroad Co.	1,000,000	50,000	1,000,000	20	17
BONDS	Auth. of Issue		Amt. Issued		
Hawaiian Govt. 5 per cent.	$ 936,000		936,000		98
Haw. Terr'l. 4 per cent Fire Claim)	500,000		269,000		
Hilo Railroad Co., 6 per cent	1,000,000		850,000		100
Hono. R. T. & L. Co, 6 p. c.	1,000,000		460,000		104
Ewa Plantation 6 per cent.	500,000		400,000		100
Oahu Railway & L'd Co. 6 p. c.	2,000,000		2,000,000		104
Oahu Plantation 6 per cent.	750 000		750 000		100
Olaa Plantation 6 per cent.	1,250,000		1,250,000		100
Waialua Agr. 6 per cent.	1,00 .000		1,000 000		100¼
Kahuku 6 per cent	200,000		200,000		100
Pioneer Mill Co., 6 per cent	1,250,000		1,250,000		100